

July 2010

# DEFENSE ACQUISITIONS

## Missile Defense Program Instability Affects Reliability of Earned Value Management Data



GAO

Accountability \* Integrity \* Reliability

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Highlights of [GAO-10-676](#), a report to congressional committees

## Why GAO Did This Study

By law, GAO is directed to assess the annual progress the Missile Defense Agency (MDA) made in developing and fielding the Ballistic Missile Defense System (BMDS). GAO issued its latest assessment of MDA's progress covering fiscal year 2009 in February 2010. This report supplements that assessment to provide further insight into MDA's prime contractor performance for fiscal year 2009. Prime contractors track earned value management (EVM) by making comparisons that inform the program as to whether the contractor is completing work at the cost budgeted and whether the work scheduled is being completed on time. Our analysis of contractor EVM data included examining contract performance reports for 14 BMDS contracts, reviewing the latest integrated baseline reviews, performing extensive analysis of data anomalies, and conducting interviews with Defense Contract Management Agency (DCMA) officials—the independent reviewers of MDA contractor EVM systems.

## What GAO Recommends

GAO recommends that MDA resolve prime contractor EVM data reliability issues by the beginning of fiscal year 2011. If, by this time, MDA has not resolved these issues, the Secretary of Defense should provide a report to Congress on the steps MDA is taking to resolve them. DOD concurred with our recommendation.

[View GAO-10-676 or key components.](#)  
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## DEFENSE ACQUISITIONS

### Missile Defense Program Instability Affects Reliability of Earned Value Management Data

## What GAO Found

Unlike GAO's reports in previous years, GAO was unable to analyze the EVM data for all MDA contracts. GAO determined that the data for the Ground-based Midcourse Defense (GMD) and Targets and Countermeasures programs were not sufficiently reliable to include in our report because of instability in these programs' baselines. When the baseline on which the work is performed and measured against is no longer representative of the program of record, program managers and other decision makers lose the ability to develop constructive corrective action plans to get the program on track. Specifically, without reliable EVM data, GAO was unable to identify significant performance drivers or forecast future cost and schedule performance. Because the two contracts associated with these programs represent half of the budgeted cost at completion for the 14 contracts GAO reviewed, GAO also determined it was not appropriate in this report to aggregate total projected underruns or overruns of the remaining 12 prime contracts as GAO has in prior reports.

The GMD prime contractor performance data was not sufficiently reliable to use as the basis for analysis because the contractor was unable to update its baseline to include numerous changes to the program and modifications to the contract. Despite three large restructures since 2007 totaling over \$2 billion, the GMD program has not conducted an integrated baseline review since December 2006. DOD acquisition policy states that an integrated baseline review is to be conducted within 6 months after contract award, exercise of contract options, or a major modification to an existing contract. The Director, MDA has taken extra steps to gain insight into the contractor's performance. Further, he intends to report EVM information to Congress annually.

Similarly, the EVM data for the Targets and Countermeasures contractor is also not sufficiently reliable to use in our analysis. DCMA identified several issues with the stability of the Targets and Countermeasures program baseline including a large amount of schedule and quantity changes to planned flight tests and over 20 contract changes to the scope of work or corrective actions to quality issues for one of the delivery orders over the course of a year. Because the contractor has not been able to update the established budget in the baseline, the cost performance reports do not reflect an appropriate baseline against which to measure cost and schedule progress. Nine of the remaining twelve contracts experienced cost overruns for fiscal year 2009 mostly because of issues with maturing technologies, immature designs, or other technical issues. For example, the Airborne Laser contractor experienced a failure in some of the system's optics which required it to develop and procure new high power optics, delaying the test schedule and increasing program cost.

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# Contents

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<b>Letter</b>		<b>1</b>
	Background	3
	EVM Data for the GMD and Targets and Countermeasures Programs Are Not Sufficiently Reliable	9
	BMDS Prime Contractors Aggregate Analysis Not Appropriate Due to Data Reliability Issues	15
	Conclusions	15
	Recommendation for Executive Action	16
	Agency Comments and Our Evaluation	16
<b>Appendix I</b>	<b>Comments from the Department of Defense</b>	<b>19</b>
<b>Appendix II</b>	<b>BMDS Prime Contractor Fiscal Year 2009 Cost and Schedule Performance</b>	<b>21</b>
	Aegis BMD Contractors Experienced Mixed Performance during the Fiscal Year	23
	ABL Cost and Schedule Performance Declined during Fiscal Year 2009	30
	C2BMC Overrunning Cumulative Cost and Schedule	32
	Sensors Contractor Experienced Mixed Performance during the Fiscal Year	34
	STSS Maintained Schedule Performance, but Cost Performance Continued to Decline during the Fiscal Year	38
	THAAD Development Contract Overran Cost and Schedule While THAAD Fire Unit Fielding Production Contract Experienced Underruns	40
<b>Appendix III</b>	<b>Scope and Methodology</b>	<b>45</b>
<b>Appendix IV</b>	<b>GAO Contact and Staff Acknowledgments</b>	<b>47</b>
<b>Tables</b>		
	Table 1: MDA's BMDS Elements and Prime Contracts	5
	Table 2: DCMA Compliance Rating and GAO Reliability Assessment for MDA Prime Contractor EVM Systems	13

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## Figures

Figure 1: Depiction of Notional Contractor Cumulative Cost and Schedule Performance	22
Figure 2: Aegis BMD Weapon System Cumulative Cost and Schedule Performance	24
Figure 3: Aegis BMD SM-3 Contract for 27 Block IA Missiles Cumulative Cost and Schedule Performance	26
Figure 4: Aegis BMD SM-3 Contract for 24 Block IA Missiles Cumulative Cost and Schedule Performance	27
Figure 5: Aegis BMD SM-3 Block IA and IB Technical Development and Engineering Cumulative Cost and Schedule Performance	29
Figure 6: ABL Cumulative Cost and Schedule Performance	31
Figure 7: C2BMC Cumulative Cost and Schedule Performance	33
Figure 8: BMDS Radars Cumulative Cost and Schedule Performance	35
Figure 9: AN/TPY-2 Radar #7 Cumulative Cost and Schedule Performance	36
Figure 10: Thule Radar Cumulative Cost and Schedule Performance	37
Figure 11: STSS Cumulative Cost and Schedule Performance	39
Figure 12: THAAD Development Cumulative Cost and Schedule Performance	41
Figure 13: THAAD Fire Unit Fielding Production Cumulative Cost and Schedule Performance	43

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## Abbreviations

ABL	Airborne Laser
Aegis BMD	Aegis Ballistic Missile Defense
AN/TPY-2	Army Navy/Transportable Radar Surveillance - Model 2
BMDs	Ballistic Missile Defense System
C2BMC	Command, Control, Battle Management, and Communications
DCMA	Defense Contract Management Agency
DOD	Department of Defense
EVM	Earned Value Management
GMD	Ground-based Midcourse Defense
IBR	Integrated Baseline Review
MDA	Missile Defense Agency
SM-3	Standard Missile-3
STSS	Space Tracking and Surveillance System
THAAD	Terminal High Altitude Area Defense
U.S.C.	United States Code

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United States Government Accountability Office  
Washington, DC 20548

July 14, 2010

In 2002, the President of the United States directed the Department of Defense (DOD) to begin fielding an initial Ballistic Missile Defense System (BMDS) capable of defending the U.S. homeland, deployed troops, friends, and allies against ballistic missiles of all ranges in all phases of flight. The Missile Defense Agency (MDA), established to develop and deploy these missile defense capabilities, began delivering an initial capability by concurrently developing and fielding assets. MDA is the DOD's largest single acquisition program—spending from approximately \$7 billion to \$9.5 billion per year.

To more effectively manage complex investments such as these, in December 1996 the Under Secretary of Defense for Acquisition and Technology signed a memorandum announcing DOD's adoption of industry standards for earned value management (EVM) systems for use on defense acquisitions.<sup>1</sup> EVM is a project management approach that, if implemented appropriately, provides objective reports of project status, produces early warning signs of impending schedule delays and cost overruns, and provides unbiased estimates of anticipated costs at completion.

This report provides an in-depth analysis of MDA's prime contractor fiscal year 2009 EVM cost and schedule progress. Congress directed GAO in its fiscal year 2002, 2007, and 2008 National Defense Authorization Acts, to assess the cost, schedule, testing, and performance progress that MDA is making in developing the BMDS.<sup>2</sup> We have delivered assessments of MDA's progress covering fiscal years 2003 through 2009, issuing our latest

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<sup>1</sup> Earned value management is a program management tool that integrates the technical, cost, and schedule parameters of a contract. During the planning phase, an integrated baseline is developed by time-phasing budget resources for defined work. As work is performed and measured against the baseline, the corresponding budget value is "earned." Using this earned value metric, cost and schedule variances can be determined and analyzed.

<sup>2</sup> National Defense Authorization Act for Fiscal Year 2002, Pub. L. No. 107-107, § 232(g) (2001); Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, Pub. L. No. 108-375, § 233 (2004); National Defense Authorization Act for Fiscal Year 2006, Pub. L. No. 109-163, § 232 (2006); John Warner National Defense Authorization Act for Fiscal Year 2007, Pub. L. No. 109-364, § 224 (2006); and National Defense Authorization Act for Fiscal Year 2008, Pub. L. No. 110-181, § 225 (2008).

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assessment of fiscal year 2009 in February 2010.<sup>3</sup> As we reported in our February 2010 report, although our annual assessments usually include analysis of EVM data for MDA contractors, this year we are reporting on this information separately.

To assess progress during fiscal year 2009, we examined contract performance reports for 14 BMDS contracts that were managed by eight BMDS program elements.<sup>4</sup> However, we were only able to report our analysis of EVM data for 12 of these 14 contracts in appendix II due to concerns with data reliability. The data for the Ground-based Midcourse Defense and the Targets and Countermeasures contracts were not sufficiently reliable for inclusion in our analysis. The 14 contracts we reviewed EVM data for are:

- Aegis Ballistic Missile Defense (BMD) weapon system software;
- two Aegis BMD SM-3 Block IA contracts for
  - a fourth lot of 27 missiles and
  - another lot of 24 missiles;
- Aegis BMD SM-3 Block IA and IB missile technology development and engineering;
- Airborne Laser (ABL);<sup>5</sup>
- three Sensors' contracts
  - BMDS radars,
  - Army Navy/Transportable Radar Surveillance—Model 2 (AN/TPY-2) radar #7, and

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<sup>3</sup> We did not assess MDA's progress in fiscal year 2002 as the agency did not establish goals for that fiscal year. We delivered the following reports for fiscal years 2003 through 2007: GAO, *Missile Defense: Actions Are Needed to Enhance Testing and Accountability*, [GAO-04-409](#) (Washington, D.C.: Apr. 23, 2004); *Defense Acquisitions: Status of Ballistic Missile Defense Program in 2004*, [GAO-05-243](#) (Washington, D.C.: Mar. 31, 2005); *Defense Acquisitions: Missile Defense Agency Fields Initial Capability but Falls Short of Original Goals*, [GAO-06-327](#) (Washington, D.C.: Mar. 15, 2006); *Defense Acquisitions: Missile Defense Acquisition Strategy Generates Results but Delivers Less at a Higher Cost*, [GAO-07-387](#) (Washington, D.C.: Mar. 15, 2007); *Defense Acquisitions: Progress Made in Fielding Missile Defense, but Program Is Short of Meeting Goals*, [GAO-08-448](#) (Washington, D.C.: Mar. 14, 2008); *Defense Acquisitions: Production and Fielding of Missile Defense Components Continue with Less Testing and Validation Than Planned*, [GAO-09-338](#) (Washington, D.C.: Mar. 13, 2009); and *Defense Acquisitions: Missile Defense Transition Provides Opportunity to Strengthen Acquisition Approach*, [GAO-10-311](#) (Washington, D.C.: Feb. 25, 2010).

<sup>4</sup> BMDS elements are separate ongoing units to address a different facet of missile defense, but that work in unison to make up the greater BMDS.

<sup>5</sup> Since September 2009, MDA has renamed this program the Airborne Laser Test Bed.



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- Thule upgraded early warning radar;
  - Command and Control, Battle Management, and Communications (C2BMC);
  - Ground-based Midcourse Defense (GMD);
  - Space Tracking and Surveillance System (STSS);
  - Targets and Countermeasures; and
  - two Terminal High Altitude Area Defense (THAAD) contracts for
    - development and
    - fire unit fielding production.

Because we were only able to analyze EVM data for 12 of 14 contracts, this report does not provide a BMDS-level analysis as we have provided in previous years, again, because of data reliability concerns. To perform our review of the EVM data for 14 contracts, we included several checks to ensure data reliability including reviewing the most current documentation on contractor performance data systems for each of the contractor sites, reviewing the latest integrated baseline review (IBR) for each contract, and following up with each program office to track how identified risks are being addressed. In addition, we checked the reliability of the performance data by consulting with earned value experts who provided us with tools to perform extensive analysis to independently review the data. We followed up on the results of this analysis tool with the program office and further reviewed its responses with the Defense Contract Management Agency (DCMA), which independently reviews all of the MDA contractor EVM systems. Our scope and methodology is discussed in more detail in appendix III.

We conducted this performance audit from February 2010 to July 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Background

MDA's mission is to develop an integrated and layered BMDS to defend the United States, its deployed forces, allies, and friends. In order to meet this mission, MDA is developing a highly complex system of systems—land-, sea- and space-based sensors, interceptors and battle management. Since its initiation in 2002, MDA has been given a significant amount of flexibility in executing the development and fielding of the BMDS. To enable MDA to field and enhance a missile defense system quickly, the Secretary of Defense in 2002 delayed the entry of the BMDS program into the DOD's

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traditional acquisition process until a mature capability was ready to be handed over to a military service for production and operation.<sup>6</sup> Because MDA does not follow the traditional acquisition process, it has not yet triggered certain statutory and regulatory requirements that other major defense acquisition programs are required to adhere to.<sup>7</sup>

For example, other major defense acquisition programs are required to establish the total scope of work and total cost baselines as part of their entry into the formal acquisition cycle. Title 10 United States Code (U.S.C.) section 2435 requires a baseline description for major defense acquisition programs, however the requirement to establish a baseline is not triggered until a system enters into system development and demonstration. DOD has implemented this requirement with the acquisition program baseline in its acquisition policy.<sup>8</sup> Because the BMDS has not yet formally entered the acquisition cycle, it has not yet been required to meet the minimum requirements of section 2435. Therefore, because of the Secretary of Defense's decision to delay entry of the BMDS system into the acquisition cycle, MDA is not required to establish the full scope of work or total cost baselines.<sup>9</sup> Since we began annual reporting on missile defense in 2004, we have been unable to assess overall progress on cost. As a result, one of the only tools available for us to use in assessing BMDS costs is the costs reported on individual contracts.

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<sup>6</sup> Secretary of Defense Memorandum "Missile Defense Program Direction" (Jan. 2, 2002).

<sup>7</sup> The BMDS program meets the definition of a major defense acquisition program, which is defined in 10 U.S.C. § 2430.

<sup>8</sup> DOD Directive 5000.01 (May, 2003) and DOD Instruction 5000.02 (Dec. 2008).

<sup>9</sup> Though MDA is not yet required to meet the requirements to establish a baseline under 10 U.S.C. § 2435, Congress has enacted legislation requiring MDA to establish some baselines. The Fiscal Year 2005 National Defense Authorization Act, Pub. L. No. 108-375, § 234(e), required the Director, MDA, to establish and report annually to Congress a cost, schedule, and performance baseline for each block configuration being fielded. MDA has since terminated its block approach. In addition, the National Defense Authorization Act for Fiscal Year 2008, Pub. L. No. 110-181, § 223(g) required that no later than the submittal of the budget for fiscal year 2009, MDA shall "establish acquisition cost, schedule and performance baselines" for BMDS elements that have entered the equivalent of system development and demonstration or are being produced and acquired for operational fielding.

MDA employs prime contractors to accomplish different tasks that are needed to develop and field the BMDS. Prime contractors receive the bulk of funds MDA requests each year and work to provide the hardware and software for elements of the BMDS.

Table 1 provides a brief description of eight BMDS elements and the prime contracts associated with these elements currently under development by MDA.

Table 1: MDA's BMDS Elements and Prime Contracts

BMDS element	Element description	Prime contracts associated with element	Contractor
Aegis BMD	Aegis BMD is a ship-based missile defense system designed to destroy short- to intermediate-range ballistic missiles during the midcourse phase of its flight.	Aegis Weapon System contract for software systems	Lockheed Martin Mission Systems and Sensors
		Two Aegis BMD contracts for the production of SM-3 Block IA missiles for a fourth lot of 27 missiles and another lot of 24 missiles	Raytheon
		Aegis BMD SM-3 Block IA and IB missile technology development and engineering contract for development efforts on the Aegis BMD SM-3 Block IB missile, the production of one SM-3 Block IB flight test missile, and efforts to support SM-3 Block IA sustainment engineering and flight test support	
ABL	ABL is an aircraft-based missile defense system designed to destroy all classes of ballistic missiles during the boost phase of their flight. ABL employs a high-energy chemical laser to rupture a missile's motor casing, causing the missile to lose thrust or flight control.	ABL contract to build and test the airborne laser weapon system	Boeing

<b>BMDS element</b>	<b>Element description</b>	<b>Prime contracts associated with element</b>	<b>Contractor</b>
C2BMC	C2BMC is the integrating element of the BMDs. Its role is to provide deliberate planning, situational awareness, sensor management, and battle management for the integrated BMDs. C2BMC delivers hardware and software capabilities in spiral development drops—the current operational delivery is Spiral 6.2 and the program is currently developing Spiral 6.4 planned for delivery in the first quarter of fiscal year 2011.	C2BMC contract to develop, test, and field an integrating system for the BMDs	Lockheed Martin Information Systems & Global Services
GMD	GMD is a ground-based missile defense system designed to destroy intercontinental ballistic missiles during the midcourse phase of their flight. Its mission is to protect the U.S. homeland against ballistic missile attacks from North Korea and the Middle East. MDA is planning on emplacing 30 operational interceptors at Fort Greely, Alaska, and Vandenberg Air Force Base, California, by the end of fiscal year 2010.	GMD contract to develop and deploy the ground-based system	Boeing
Sensors	MDA is developing various stand-alone radars for fielding. These include forward-based sensors; mobile, sea-based sensors, such as the Sea-based X-band Radar; and upgrades to existing early-warning radars. The BMDs use these sensors to identify and continuously track ballistic missiles in all phases of flight.	<p>BMDs radars contract for the development and production for four AN/TPY-2 radars</p> <hr/> <p>Contract for the AN/TPY-2 radar #7, a forward-based radar to be a part of the second THAAD battery</p> <hr/> <p>Contract for the Thule radar, an upgraded early warning radar</p>	Raytheon
STSS	The STSS is designed to acquire and track threat ballistic missiles in all stages of flight through the development and launch of two low-orbit demonstration satellites. In fiscal year 2009, MDA successfully launched both satellites. Over the next 2 years, the two satellites will take part in a series of tests to demonstrate their functionality and interoperability with the BMDs. There is no operational system planned for STSS.	STSS contract for development of demonstration satellites	Northrop Grumman Aerospace Systems

BMDS element	Element description	Prime contracts associated with element	Contractor
Targets and Countermeasures	MDA develops and provides a series of targets used in BMDs flight tests to present authentic threat scenarios. The targets are designed to encompass the full spectrum of threat missile ranges and capabilities.	Targets and Countermeasures contract structured by delivery orders to develop targets including short-range targets, medium-range targets, and intermediate-range targets including the Flexible Target Family's launch vehicle-2. In addition, the program develops air-launched targets for various ranges	Lockheed Martin Space Systems
THAAD	THAAD is a ground-based missile defense system designed to destroy short- and medium-range ballistic missiles during the late-midcourse and terminal phases of flight. A THAAD Battery is made up of 3 to 6 launchers, 24 to 48 interceptors, 1 fire control, 1 radar, and peculiar support equipment.	THAAD development contract to develop the hardware and software to conduct ground and flight testing to validate and verify the design of the THAAD weapon system. In addition, this contract produced a fire control and launcher for the first THAAD battery  THAAD fire unit fielding production contract to produce components of THAAD Battery #1 and #2—except for the one launcher and fire control provided by the development contract and the radars that are produced by the Sensors contractor	Lockheed Martin Space Systems Company

Source: MDA data.

Each BMDs program office's prime contractor provides monthly earned value reports which provide insight into the dollar gained or lost for each dollar invested. These Contract Performance Reports compare monthly progress to the existing cost or schedule performance baseline to reveal whether the work scheduled is being completed on time and if the work is being completed at the cost budgeted. For example, if the contractor was able to complete more work than scheduled and for less cost than budgeted, the contractor reports a positive schedule and cost variance, or "underrun". Alternatively, if the contractor was not able to complete the work in the scheduled time period and spent more than budgeted, the contractor reports both a negative schedule and cost variance, or "overrun". The results can also be mixed by, for example, completing the work ahead of schedule (a positive schedule variance) but spending more than budgeted to do so (a negative cost variance).

We also used contract performance report data to base projections of likely overrun or underrun of each prime contractor's budgeted cost at

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completion. Our projections of overruns or underruns to the budgeted cost at completion are based on the assumption that the contractor will continue to perform in the future as it has in the past. In addition, since the budgeted cost at completion provides the basis for our projected overruns, we also provide it for each contract we assessed in appendix II.<sup>10</sup>

In addition, as part of the yearly system compliance verification process, DCMA conducts a periodic surveillance of contractor EVM systems to determine initial and continuing compliance of those management systems with government accepted standards.<sup>11</sup> Surveillance (routine evaluation and assessment) of the EVM systems is mandatory for all contracts that require EVM systems compliance.<sup>12</sup> Surveillance ensures that the contractor is meeting contractual terms and conditions and is in compliance with applicable policies and regulations. DCMA has primary responsibility for surveillance of the prime contractor and sub-tier suppliers with EVM requirements. According to a DCMA Earned Value Management Center official responsible for leading system surveillance, at the completion of the assessment, the DCMA Earned Value Management Center submits to the contracting officer a status of the contractor's EVM system compliance, including all supporting data to that effect.

If deficiencies are found during the course of the surveillance process, it is the surveillance team's responsibility, working through DCMA's Earned Value Management Center, to issue a written corrective action request. The purpose of a corrective action request is to formally notify the contractor that a documented course of action in the form of a corrective

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<sup>10</sup> The budget at completion represents the total planned value of the contract.

<sup>11</sup> American National Standards Institute/Electronics Industries Alliance -748 is a collection of 32 earned value management system guidelines that incorporate business best practices for program management systems proven to provide strong benefits for program or enterprise planning and control. The processes include integration of program scope, schedule, and cost objectives, establishment of a baseline plan for accomplishment of program objectives, and use of earned value techniques for performance measurement during the execution of a program. The system provides a sound basis for problem identification, corrective actions, and management replanning as required.

<sup>12</sup> DOD's Earned Value Implementation Guide states that surveillance of management control systems is required for all contract efforts that require EVM compliance with American National Standards Institute/Electronics Industries Alliance -748. According to the Defense Federal Acquisition Regulation Supplement, contractors with cost and incentive contracts with values over certain thresholds shall use an earned value management system that complies with the 32 earned value management system guidelines established by American National Standards Institute/Electronics Industries Alliance -748.

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action plan is needed to bring the EVM system in compliance with government accepted EVM system guidelines. Corrective action requests range in severity from Level I to Level IV where, according to a DCMA Earned Value Management Center official responsible for leading system surveillance, Level I is for non-compliance with the Defense Federal Regulation Acquisition Supplement clauses in the contract that can be corrected immediately and for which no special management attention is required, and Level IV identifies issues where cost, schedule, technical performance, resources, or management process issues have unfavorably affected the supplier's EVM so that it is incapable of reporting meaningful EVM across multiple programs or multiple sites; and these issues have not been corrected. Level III and IV corrective action requests may trigger formal reviews such as post award review for cause, compliance reviews, or other system validation reviews and may result in suspension or revocation of EVM systems certification.

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## **EVM Data for the GMD and Targets and Countermeasures Programs Are Not Sufficiently Reliable**

For GMD and Targets and Countermeasures, we determined that the EVM data were not sufficiently reliable to analyze these contracts' cost and schedule performance because of instability in these programs. Without reliable EVM data, we are unable to identify significant performance drivers or forecast future cost and schedule performance. Further, when the baseline on which the work is performed and measured against is no longer representative of the program of record, program managers and other decision makers lose the ability to develop constructive corrective action plans to get the program on track. These reliability issues affect MDA's oversight of contractor progress and both MDA and GAO's ability to report this progress to external parties and Congress. MDA officials were aware that significant changes were not reflected in the baselines for these two elements and have been conducting more extensive oversight to compensate, but did not alert us to this issue during the course of our audit. The Director, MDA has acknowledged the importance of EVM and to address some of these issues he has enacted quarterly reviews of each of the program's baselines. Further, he intends to report EVM information to Congress annually.

According to DCMA officials, there were several issues associated with the Boeing EVM system for GMD. One of the main issues was the contractor's inability to maintain a consistent performance measurement baseline. With numerous changes to the program and modifications to the contract, the contractor experienced difficulty incorporating these changes into the baseline in order to measure performance against this new work. For example, although the GMD program experienced a \$1.3 billion dollar

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restructure in 2007, another major restructure beginning in fiscal year 2008 for over \$500 million that was completed in fiscal year 2009,<sup>13</sup> and a third in fiscal year 2010 for over \$380 million, the GMD program has not conducted an IBR<sup>14</sup> since December 2006.<sup>15</sup> DOD's acquisition policy states that an IBR is to be conducted within 6 months after contract award, exercise of contract options, or major modifications to a contract.<sup>16</sup> DCMA officials told us that the GMD program had an IBR underway following the restructure that began in fiscal year 2008 and completed in fiscal year 2009, but in May 2009 the program was again redirected and the baseline review was cancelled.<sup>17</sup>

The Director, MDA explained that some of the GMD program's baseline instability from frequent restructures was related to the changing GMD role in European defense. The February 2007 budget request for fiscal year 2008 included an approach to European defense focused on GBIs from the GMD element and a large fixed radar as well as transportable X-Band radars. In September 2009, the administration altered its approach to European defense and instead constructed a defense system to consist primarily of Aegis BMD sea-based and land-based systems and interceptors, as well as various sensors to be deployed over time as the various capabilities are matured. The Director told us that these European

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<sup>13</sup> MDA notes that the two major program restructures in 2007 and fiscal year 2008 were accomplished via an alpha contracting process. During this process, there is joint government and contractor participation including agreement on scope and requirements development, integrated schedules, and amount and time phasing of resources. Although these activities satisfy some IBR objectives, alpha contracting is not a substitute for conducting an IBR.

<sup>14</sup> An integrated baseline review verifies the technical content of the baseline. It also ensures that contractor personnel understand and have been adequately trained to collect EVM data. In addition, the review verifies the accuracy of the related budget and schedules, ensures that risks have been properly identified, assesses the contractor's ability to implement proper earned value management, and determines if the work identified by the contractor meets the program's objectives. The government's program manager and technical staff carry out this review with their contractor counterparts.

<sup>15</sup> The GMD program has conducted integrated baseline reviews on a subcontract effort at the Fort Greely Power Plant, but has not conducted a comprehensive integrated baseline review of the contract.

<sup>16</sup> Department of Defense Instruction, 5000.02 (Dec. 2, 2008).

<sup>17</sup> The MDA Director told us that the IBR was canceled because the proposed budget changes would have reduced the program's budget by nearly half. Later, the program's funding was restored and a subsequent restructure was issued in October 2009.



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capability requirements changes drastically affected the GMD program as a significant amount of work had to be restructured.

During these three to four years of GMD baseline instability, the Director, MDA told us that MDA took steps to gain additional insight into the contractor's progress. The program held added reviews in the absence of IBRs to understand planned near-term effort and how well they were executing against those plans. In addition, the Director told us that the program held monthly focus sessions during which the joint government and contractor teams briefed the status of progress and risks. The Director acknowledged that these insights are necessary to understand the meaning of the near-term EVM data. However, without the benefit of a documented IBR after multiple larger restructures to the program or being made aware of MDA's added reviews, we do not have sufficient confidence in the GMD program performance measurement baseline to reliably analyze the existing EVM data.

Boeing and MDA are taking steps to address problems with the reliability of the contractor's EVM data. The contractor had planned to deliver a performance measurement baseline by May 2010 and the GMD program is planning to conduct a series of IBRs on the remaining prime and major subcontractor effort beginning in July 2010. In addition, the contractor is taking initiatives to put a performance measurement baseline in place as quickly as possible and is providing additional training for its management and control account managers in charge of EVM. The Director, MDA told us that MDA was changing how its future contracts for the GMD program are being structured to be more receptive to modifications. This new contract structure will include dividing the work into delivery orders so that modifications will be reflected at a delivery order level instead of affecting a larger contract. These steps may help resolve the EVM issues; however we cannot determine the full effect of these steps until further evaluation after their full implementation.

Similarly, we have determined that the EVM data for the Targets and Countermeasures contractor, Lockheed Martin Space Systems, are not sufficiently reliable for inclusion in our analysis. Based on discussions with and reports issued by DCMA, the Targets and Countermeasures contractor was unable to update its baseline because of numerous program changes. In September 2007, when the delivery order for the launch vehicle-2 was approximately 60 percent complete, Lockheed Martin signaled that its baseline was no longer valid by requesting a formal reprogramming of the effort to include an overrun in its baseline for this delivery order. MDA allowed the contractor to perform a schedule

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rebaseline and remove schedule variances – but did not provide any more budget for the recognized overrun in the performance measurement baseline. As a result, DCMA reported that the performance indicators for this delivery order, needed to estimate a contract cost at completion, were unrealistic. According to the Director, MDA did not believe the contractor had justified that there was a scope change warranting additional budget in the performance measurement baseline. He said he believed doing so would mask problems the contractor was experiencing planning and executing the contract which he identified as the issue as opposed to changes in the contract's scope. According to the Director, one example of the issues the contractor was experiencing on this delivery order included a failure rate of 64 percent on production qualification components. MDA has since completed the work on this delivery order and begun managing follow-on target production on a newly established delivery order.

In addition, during fiscal year 2009 DCMA identified several issues with the stability of the Targets and Countermeasures program baseline. For example, program changes since fiscal year 2008 on one delivery order included over 20 contract changes to the scope of work or corrective actions to quality issues. In addition, the schedule and quantity of planned flight tests changed significantly. During the fiscal year, DCMA submitted a corrective action request for noncompliance with incorporating authorized changes in a timely manner although the contractor was able to close this issue before the end of the reporting period. Because of the instability in the baseline and the contractor's inability to update the baseline with these frequent changes, we determined the cost performance reports for 2009 do not reflect an appropriate baseline against which to measure cost and schedule progress.

According to the Director, MDA, the agency has undertaken a major effort to stabilize the Targets and Countermeasures program. MDA has established a new target acquisition strategy to address recurring target performance issues and increases in target costs. In this new strategy, the agency will buy generic targets in larger lots that are not tied to a particular test instead of smaller lots. This effort should also help increase MDA's flexibility to respond to changing program requirements. In addition, the Director, MDA told us that the Director of Engineering at MDA will define target requirements instead of the program manager which should also help create more stability.

## Despite Non-Compliance Ratings for MDA Prime Contractor EVM Systems, Most Were Sufficiently Reliable for GAO Review

During the course of our review, we found that DCMA assessed 7 of the 14 contractors' EVM systems as noncompliant in fiscal year 2009. DCMA also rated 3 of the 14 contractors systems as unassessed. We reviewed the basis for the noncompliance and unassessed ratings and determined that only the GMD and Targets and Countermeasures contractor EVM issues affected the reliability of the data for our purposes. See table 2 for the DCMA compliance ratings for the 14 MDA prime contracts' EVM systems and GAO's reliability assessment.

**Table 2: DCMA Compliance Rating and GAO Reliability Assessment for MDA Prime Contractor EVM Systems**

Contracts	Contractor site EVM system compliance rating for 2009			GAO determination Not sufficiently reliable
	Not assessed	Compliant	Noncompliant	
Aegis BMD Weapon System	X			
Aegis BMD SM-3 Block IA missiles for fourth lot of 27 missiles		X		
Aegis BMD SM-3 Block IA missiles for another lot of 24 missiles		X		
Aegis BMD SM-3 Block IA and IB missile technology development and engineering		X		
ABL		X		
C2BMC			X	
GMD			X	X
Sensors' BMDS Radars			X	
Sensors' AN/TPY-2 radar #7			X	
Sensors' Thule radar			X	
STSS contract			X	
Targets and Countermeasures			X	X
THAAD development	X			
THAAD fire unit fielding production	X			

Source: DCMA (data); GAO (presentation).

Note: A rating of noncompliant indicates that at least one corrective action request was open at the end of the rating assessment period. The noted noncompliance can vary significantly from a small isolated case that does not affect management data reported to being systemic across the company affecting all management data reported.

Five EVM systems besides the GMD and Targets and Countermeasures contractor EVM systems were rated as noncompliant by DCMA during the fiscal year but did not lead to GAO to conclude that the EVM data were not sufficiently reliable. In order to judge the reliability of the data, we reviewed the significance of any open corrective action request(s) that triggered a noncompliance rating and its impact on the contractor's ability

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to judge cost and schedule performance against a baseline. During the course of our audit, we interviewed DCMA representatives at each of the contractor sites to understand the basis for the noncompliance determination and to gain information to help us assess the reliability of the data.

For example, the EVM system of the STSS contractor Northrop Grumman was deemed noncompliant because of two low-level corrective action requests related to issues with other contracts that did not materially affect the performance baseline for the STSS contract we assessed. Also, the C2BMC's contractor Lockheed Martin Information Systems & Global Services received a rating of noncompliant during 2009 because of a corrective action request that stated that major subcontractor efforts were not specifically identified, assigned, or tracked in the organizational breakdown structure. However, after the noncompliant rating was given, DCMA reversed its decision and decided to close the corrective action without requiring the contractor to change its methods.

In addition, although DCMA was unable to assess two EVM systems during 2009 for Lockheed Martin Mission Systems and Sensors under the Aegis BMD weapon system contract, and Lockheed Martin Space Systems Company under the two THAAD contracts, we determined that the reasons for the unassessed rating did not lead to issues with data reliability. According to the DCMA EVM specialist responsible for monitoring the Aegis BMD weapon system, the Aegis BMD weapon system contractor was unassessed because some of the accounting guidelines could not be assessed in time for the compliance rating. In addition, the THAAD contractor was not assessed because, according to DCMA, although the contractor had addressed the open corrective action requests, DCMA did not have the resources to review and document the effectiveness of those actions in order to close these items before the end of the rating assessment period. However, subsequent to the closing of the rating assessment period, the contractor's actions were deemed sufficient by DCMA to fix the unresolved issues and the corrective action requests were closed.

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## BMDS Prime Contractors Aggregate Analysis Not Appropriate Due to Data Reliability Issues

We are unable in this year's report to aggregate total projected underruns or overruns in our analysis of the remaining 12 prime contracts because we had to exclude the GMD and Targets and Countermeasures programs due to data reliability issues. The GMD and Targets and Countermeasures prime contracts' budgeted costs at completion total nearly \$16 billion dollars or half of the total 14 contracts' budgeted cost at completion. By removing such a large portion of data from our analysis, we determined that it is inappropriate to perform any aggregate analysis. More detail is provided for each of the contractors responsible for the remaining twelve BMDS contracts' cost and schedule performance in appendix II.

Nine of the remaining 12 contracts experienced cost overruns for fiscal year 2009. Most of the overruns were because of issues with maturing technologies, immature designs, or other technical issues. For example, the ABL contractor experienced a failure in some of the system's optics which required it to develop and procure new high power optics, delaying the test schedule and increasing program cost. In addition, the THAAD development contractor expended more funds than expected for redesigns on the missile's divert and attitude control system assembly, correcting issues with its boost motor, and making changes on the design of its optical block—a safety system to prevent inadvertent launches. Also, the contractor experienced cost overruns on extended testing and redesigns for its prime power unit in the radar portion of the contract.

Contractors were able to perform within their fiscal year 2009 budgeted costs for three contracts—the Aegis BMD SM-3 contract for a fourth lot of 27 SM-3 Block IA missiles and contract for another lot of 24 SM-3 Block IA missiles, and the BMDS radars contract. The Aegis BMD SM-3 contractor attributed underruns in both of these lots of Block IA missiles to production efficiencies since the contractor has been building Aegis BMD SM-3 Block I and IA missiles for nearly 6 years. The BMDS radars contractor improved cost performance during the fiscal year through efficiencies in the software development and systems engineering.

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## Conclusions

Because MDA has not established cost baselines, prime contractor EVM data provides one of the only tools to understand MDA's cost and schedule progress, particularly for purposes of external oversight. At present that tool cannot be used effectively for two major contractors because their data are not sufficiently reliable. While MDA is taking action to stabilize its programs and thereby improve the reliability of its EVM data, any additional delays into fiscal year 2011 could affect future fiscal years' oversight. Moreover, until the data are sufficiently reliable, MDA, GAO and

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Congress lose the valuable insights into contractor performance that EVM provides, including an understanding of significant drivers to performance, the ability to forecast future cost and schedule performance, and the ability to develop constructive corrective action plans based on these results to get programs that have encountered problems back on track.

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## Recommendation for Executive Action

We recommend the Secretary of Defense direct MDA to resolve prime contractor data reliability issues by the beginning of fiscal year 2011 and, if MDA has not resolved the data reliability problems, determine the barriers preventing resolution and provide a report to Congress on:

- the steps MDA is taking to make its contractor data sufficiently reliable,
- how the data reliability issues affect MDA's ability to provide oversight of its contractors, and
- the effect these issues have on MDA's ability to report contractor progress to others, including Congress.

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## Agency Comments and Our Evaluation

DOD provided written comments on a draft of this report. These comments are reprinted in appendix I. DOD also provided technical comments, which were incorporated as appropriate.

DOD concurred with our recommendation to resolve prime contractor EVM data reliability issues by 2011; however, DOD stated that MDA considers its fiscal year 2009 prime contractor performance data to be reliable. It should be noted that, while MDA has undertaken extra measures to gain insight into and compensate for the program instability effects on its EVM data, the insights gained by MDA are not available to external organizations which depend on the EVM data to analyze and forecast trends. Without the benefit of MDA's extra measures and added reviews, we maintain that the prime contractor fiscal year 2009 EVM data are not sufficiently reliable for analysis. Although we agree that MDA will likely have better insight into the reliability of its contractor performance data once it completes its comprehensive Integrated Baseline Review process and verifies data reliability through joint surveillance of the contractor's EVM system as stated in the DOD response, we are retaining the recommendation to ensure that these corrective steps are implemented in time to improve the reliability of the EVM data by the beginning of the next fiscal year.

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We are sending copies of this report to the Secretary of Defense, the Director, MDA, and Office of Management and Budget. The report also is available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staff have any questions concerning this report, please contact me at (202) 512-4841 or [chaplainc@gao.gov](mailto:chaplainc@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix IV.

A handwritten signature in black ink, consisting of stylized, overlapping loops and a long horizontal stroke at the end.

Cristina T. Chaplain  
Director  
Acquisition and Sourcing Management

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*List of Committees*

The Honorable Carl Levin  
Chairman  
The Honorable John McCain  
Ranking Member  
Committee on Armed Services  
United States Senate

The Honorable Daniel K. Inouye  
Chairman  
The Honorable Thad Cochran  
Ranking Member  
Subcommittee on Defense  
Committee on Appropriations  
United States Senate

The Honorable Ike Skelton  
Chairman  
The Honorable Howard P. McKeon  
Ranking Member  
Committee on Armed Services  
House of Representatives

The Honorable Norman D. Dicks  
Chairman  
The Honorable C.W. Bill Young  
Ranking Member  
Subcommittee on Defense  
Committee on Appropriations  
House of Representatives



# Appendix I: Comments from the Department of Defense



OFFICE OF THE UNDER SECRETARY OF DEFENSE  
3000 DEFENSE PENTAGON  
WASHINGTON, DC 20301-3000

JUL -1 2010

Ms. Christina T. Chaplain  
Director, Acquisition and Sourcing Management  
U. S. Government Accountability Office  
441 G Street, N.W.  
Washington, DC 20548

Dear Ms. Chaplain:

This is the Department of Defense (DoD) response to the GAO Draft Report, GAO-10-676, "DEFENSE ACQUISITIONS: Missile Defense Earned Value Management Effectiveness Limited by Data Reliability Issues," dated May 28, 2010 (GAO Code 120891).

The DoD concurs with the draft report's recommendation. The rationale for our position is included in the enclosure. A list of technical and factual errors has been submitted separately for your consideration.

We appreciate the opportunity to comment on the draft report. My point of contact for this effort is Mr. David Crim, (703) 697-5385, david.crim@osd.mil.

Sincerely,

A handwritten signature in black ink, appearing to read "David G. Ahern".

David G. Ahern  
Director  
Portfolio Systems Acquisition

Enclosures:  
As stated

GAO DRAFT REPORT-DATED MAY 28, 2010  
GAO CODE 120891/GAO-10-676

"DEFENSE ACQUISITIONS: Missile Defense Earned Value  
Management Effectiveness Limited by Data Reliability Issues"

DEPARTMENT OF DEFENSE COMMENTS  
TO THE GAO RECOMMENDATIONS

**RECOMMENDATION 1:** The GAO recommends the Secretary of Defense direct MDA to resolve prime contractor data reliability issues by the beginning of fiscal year 2011 and, if MDA has not resolved the data reliability problems, determine the barriers preventing resolution and provide a report to Congress on:

- The steps MDA is taking to make its contractor data sufficiently reliable,
- How the data reliability issues affect MDA's ability to provide oversight of its contractors, and
- The effect these issues have on MDA's ability to report contractor progress to others, including Congress.

**DOD RESPONSE: Concur.** MDA considers the prime contractor data to be sufficiently reliable to assess fiscal year 2009 performance. MDA expects data reliability issues to be resolved by the beginning of fiscal year 2011 and that accurate contractor progress will be reported to outside entities, including Congress. MDA will verify data reliability through joint surveillance of the contractor's Earned value Management System and a comprehensive Integrated Baseline Review (IBR) process. All IBRs will be conducted by a joint team consisting of the program office, the contractor, and Defense Contract Management Agency (DCMA).

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# Appendix II: BMDS Prime Contractor Fiscal Year 2009 Cost and Schedule Performance

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To determine if they are executing the work planned within the funds and time budgeted, each prime contractor provides monthly reports detailing cost and schedule performance. The contractor tracks earned value management (EVM) by making comparisons that inform the program as to whether the contractor is completing work at the cost budgeted and whether the work scheduled is being completed on time and then reports this information on Contract Performance Reports.<sup>1</sup> For example, if the contractor was able to complete more work than scheduled and for less cost than budgeted, the contractor reports a positive schedule and cost variance, or “underrun”. Alternatively, if the contractor was not able to complete the work in the scheduled time period and spent more than budgeted, the contractor reports both a negative schedule and cost variance, or “overrun”. The results can also be mixed by, for example, completing the work ahead of schedule (a positive schedule variance) but spending more than budgeted to do so (a negative cost variance).

We provide two kind of variances in our individual contract assessments pertaining to overruns or underruns either cumulatively over the life of the contract or during the fiscal year. Cumulative variances are the overruns or underruns the contractor has earned since the contract began. In order to calculate fiscal year variances, we determined the contractor’s cumulative variances at the end of September 2008 and subtracted them from the cumulative variances at the end of September 2009. Fiscal year 2009 variances give us an idea of the contractor’s performance trends during the fiscal year. A contractor may have cumulative overruns but underrun its fiscal year budgeted cost or schedule by improving its cost performance over the course of the fiscal year.

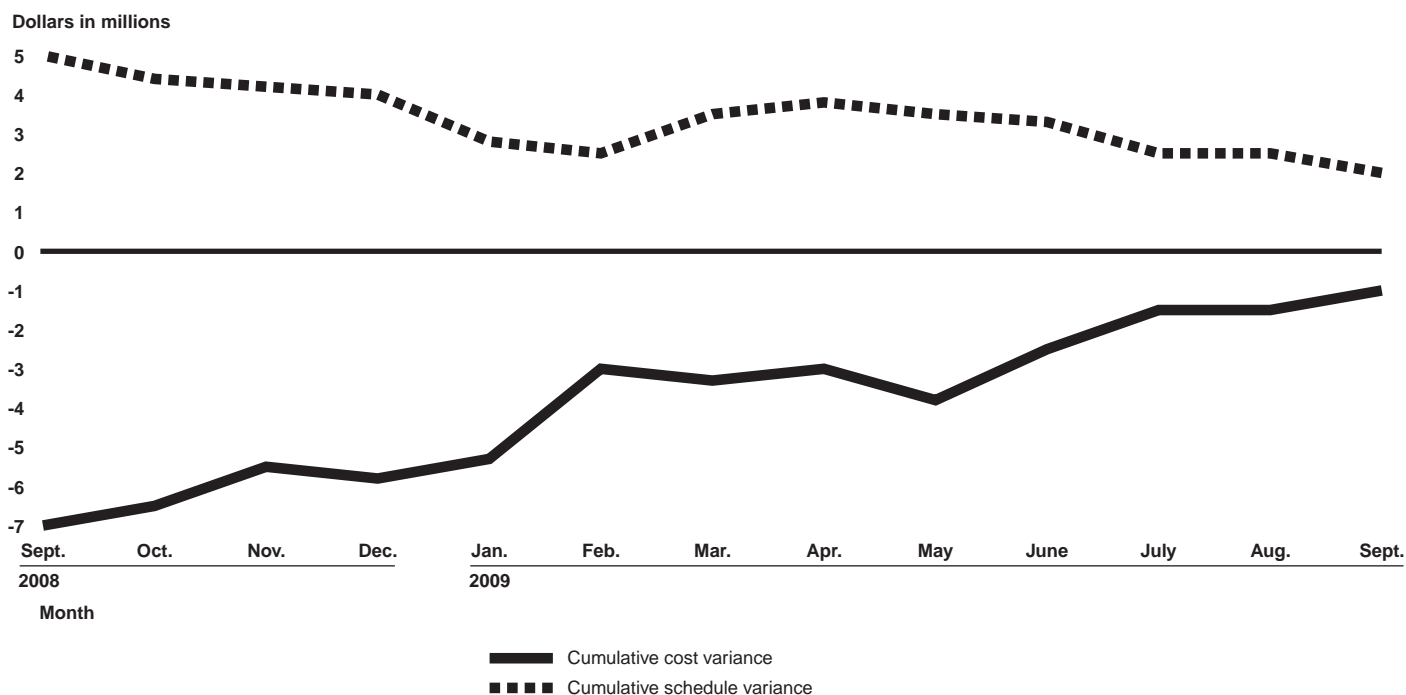
In our graphs, positive fiscal year variances (underrunning cost or schedule) are indicated by increasing performance trend lines and negative fiscal year variances (overrunning cost or schedule) are shown by decreasing performance trend lines. In our notional example in Figure 1, the positive slope of the cost variances line indicates that the contractor is underrunning fiscal year budgeted cost. Specifically, the contractor began the fiscal year with a negative cumulative cost variance of \$7.0 million but

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<sup>1</sup> Earned value management is a program management tool that integrates the technical, cost, and schedule parameters of a contract. During the planning phase, an integrated baseline is developed by time-phasing budget resources for defined work. As work is performed and measured against the baseline, the corresponding budget value is “earned.” Using this earned value metric, cost and schedule variances can be determined and analyzed.

ended the fiscal year with a negative cumulative cost variance of \$1.0 million. That means that the contractor underran its fiscal year budgeted costs by \$6.0 million and therefore has a positive \$6.0 million fiscal year cost variance. Alternately, the cumulative schedule variance is decreasing during the fiscal year indicating that the contractor was unable to accomplish planned fiscal year work and therefore has a negative fiscal year schedule variance. In this case, the schedule performance declined during the fiscal year from \$5.0 million down to \$2.0 million. Therefore, the contractor was unable to accomplish \$3.0 million worth of work planned during the fiscal year.

Figure 1: Depiction of Notional Contractor Cumulative Cost and Schedule Performance



Source: GAO.

The individual points on Figure 1 also show the cumulative performance over the entire contract up to each month. Points in a month that are above \$0 million represent a positive cumulative variance (underrunning cost or schedule) and points below \$0 million represent a negative cumulative variance (overrunning cost or schedule). In our notional example, the contractor ended the fiscal year with a negative cumulative cost variance of \$1.0 million. This means that since the contract's inception, the contractor is overrunning its budgeted cost by \$1.0 million.

Alternately, the contractor ended the fiscal year with a positive cumulative schedule variance of \$2.0 million. That means that over the life of the contract, the contractor has been able to accomplish \$2.0 million more worth of work than originally planned.

Besides reporting cost and schedule variances, we also used contract performance report data to base projections of likely overrun or underrun of each prime contractor's budgeted cost at completion. Our projections of overruns or underruns to the budgeted cost at completion are based on the assumption that the contractor will continue to perform in the future as it has in the past. Our projections are based on the current budgeted costs at completion for each contract we assessed, which represents the total planned value of the contract as-of September 2009. However, the budgeted costs at completion, in some cases, have grown significantly over time. For example, the Airborne Laser (ABL) contractor reported budgeted costs at completion totaling about \$724 million in 1997, but that cost has since grown to about \$3.7 billion.

Our assessment only reveals the overrun or underrun since the latest adjustment to the budget at completion. It does not capture, as cost growth, the difference between the original and current budgeted costs at completion. As a result, comparing the underruns or overruns for Missile Defense Agency (MDA) programs with cost growth on other major defense acquisition programs is not appropriate because MDA has not developed the full scope of work and total cost baselines that other major defense acquisition programs have.

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## Aegis BMD Contractors Experienced Mixed Performance during the Fiscal Year

The Aegis Ballistic Missile Defense (BMD) program employs two prime contractors for its two main components—Lockheed Martin Mission Systems and Sensors for the Aegis BMD Weapon System and Raytheon for the Aegis BMD Standard Missile-3 (SM-3). During fiscal year 2009, the Aegis BMD SM-3 Block IA and IB missile technology development and engineering contract experienced declining cost and schedule performance, the Aegis BMD SM-3 contract for a fourth lot of 27 Block IA missiles had increasing cost and schedule performance, and the Aegis Weapon System and Aegis BMD SM-3 contractor for another lot of 24 SM-3 Block IA missiles experienced mixed performance.

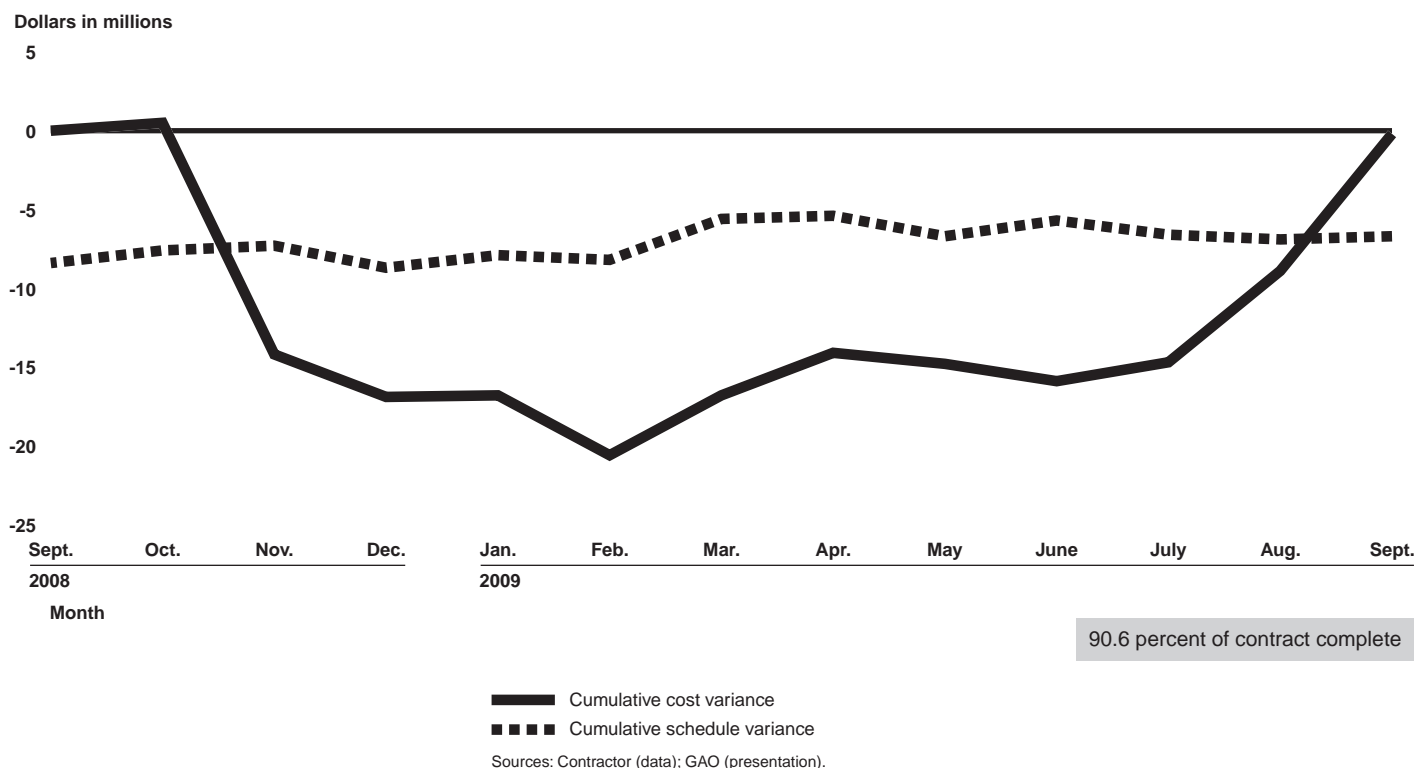
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## Aegis BMD Weapon System

Although the Aegis Weapon System contractor overran fiscal year 2009 budgeted costs by \$0.2 million, it was able to accomplish \$1.7 million more worth of work than originally anticipated. The fiscal year 2009 cost

overrun is attributed to unplanned complexity associated with developing radar software. During the fiscal year, the decline in cost performance and subsequent recovery is partially attributed to annual technical instruction baseline updates. These baseline updates occur over the course of a sixty day period during which varying performance data occurs. At the end of this period, there is a jump in performance as the contractor earns two months worth of performance. Some of the cost savings from April through September 2009 are the result of a planned flight test being cancelled during the fiscal year and the contractor not spending intended funds on pre-flight test, flight test, and post-flight test activities. The favorable schedule variance was driven by completion of some technical instruction efforts. Figure 2 shows cumulative variances at the beginning of fiscal year 2009 along with a depiction of the contractor's cost and schedule performance throughout the fiscal year.

**Figure 2: Aegis BMD Weapon System Cumulative Cost and Schedule Performance**



Considering prior performance on the Aegis Weapon System contract since it began performance in October 2003, the contractor is \$0.2 million

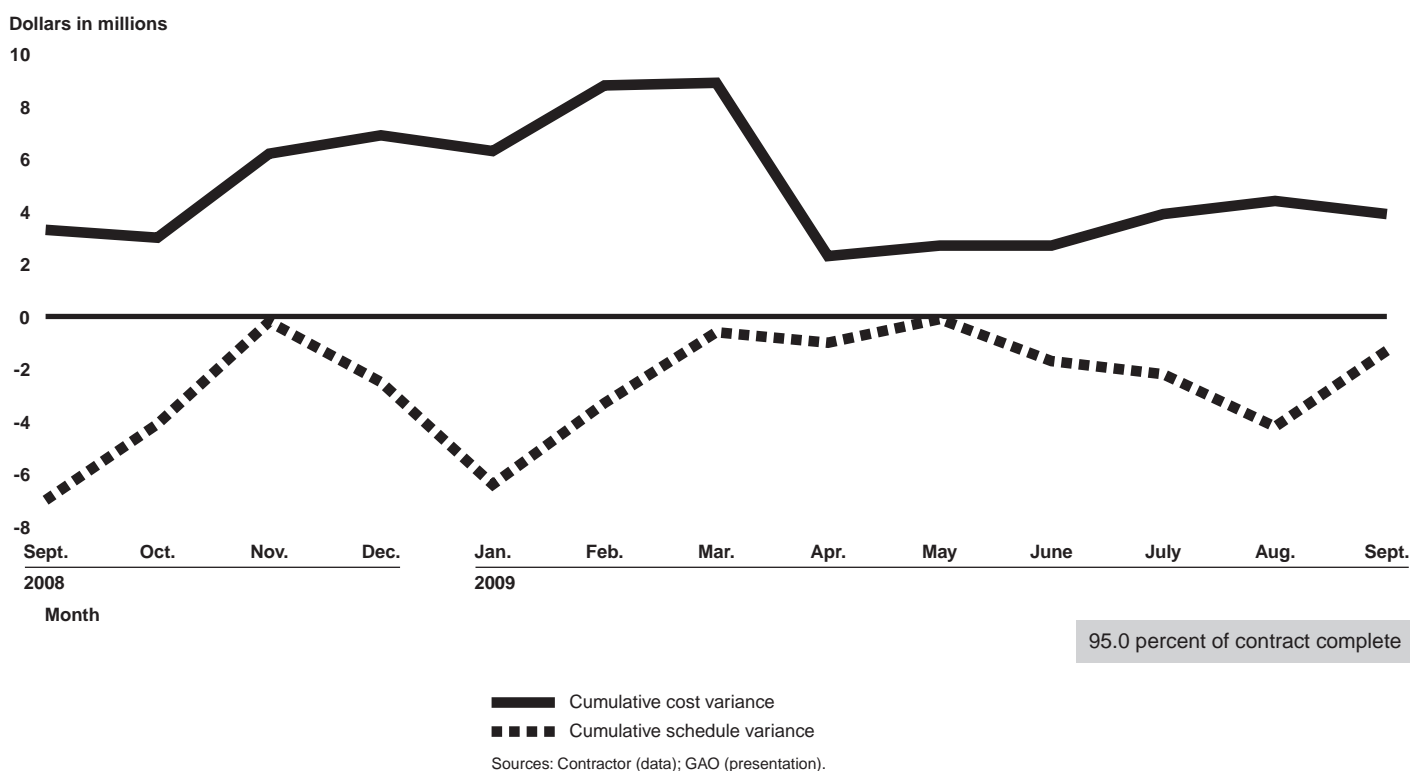
over budget and has been unable to accomplish \$6.7 million worth of work. The small negative cost variance was driven primarily by radar software development issues, including a significant redesign not included in the original baseline. In addition, the engineering test and evaluation portion of the radar software is experiencing an increase in the lines of code that also accounts for some of the budget overrun. The unfavorable \$6.7 million in schedule variances are attributed to the engineering test and evaluation portion of the radar software for which builds and capabilities are being delivered later than originally planned. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in June 2010, the work under the contract could cost about \$0.2 million more than the budgeted cost of \$1.5 billion.

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#### Aegis BMD SM-3 for 27 Block IA Missiles

The Aegis BMD SM-3 contractor for a fourth lot of 27 Block IA missiles underran its budgeted fiscal year 2009 cost and schedule by \$0.5 million and \$5.8 million respectively. The program attributed its cost and schedule underruns to efficiencies in producing Aegis BMD SM-3 Block I and IA missiles since the contractor has been building these missiles for nearly 6 years. Additionally, the program reported that the contract incentivizes the contractor to deliver missiles ahead of schedule for maximum incentive fee which further encouraged the contractor to accomplish \$5.8 million more worth of work than originally planned during the fiscal year. See figure 3 for an illustration of cumulative cost and schedule variances during the course of the fiscal year.

Figure 3: Aegis BMD SM-3 Contract for 27 Block IA Missiles Cumulative Cost and Schedule Performance



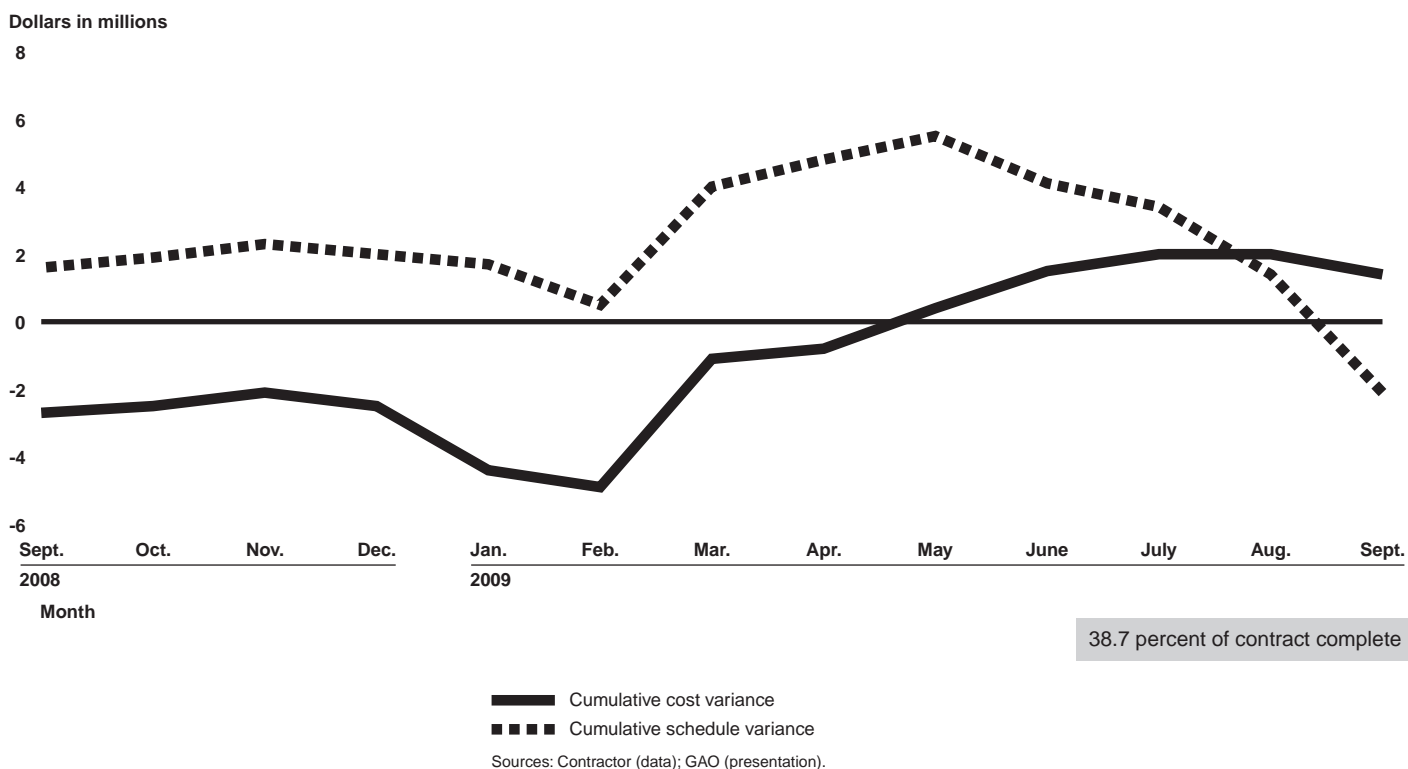
Considering prior years' performance since the contract began in May 2007, the contractor is performing under budgeted cost with a favorable cumulative cost variance of \$3.9 million but is behind schedule on \$1.3 million worth of work. The cost underruns are primarily driven by implemented efficiencies, material transfers, and program management adjustments within the solid divert and attitude control system; a decrease in rework and more efficiencies realized with the seeker; and underruns in engineering efforts associated with the third stage rocket motor. The \$1.3 million in schedule overruns are attributed to late delivery of parts as the result of some equipment failures. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in December 2011, the work under the contract could cost about \$5.2 million less than the budgeted cost of \$233.8 million.



## Aegis BMD SM-3 for 24 Block IA Missiles

As of September 2009, the Aegis BMD SM-3 contractor for another lot of 24 Block IA missiles had underrun its fiscal year budget by \$4.2 million and was behind in completing \$3.7 million worth of work. The contractor attributes its cost underrun to efficiencies in program management and systems engineering because of its experience in building SM-3 Block I and IA missiles. The \$3.7 million in schedule overruns resulted from the contractor planning the baseline to a more aggressive schedule than the contractual missile delivery schedule requires. The contractor plans in this way because it is incentivized to deliver missiles 2 months ahead of schedule. As a result, negative schedule variances have occurred as the contractor is pushing to deliver missiles early. Figure 4 shows both cost and schedule trends during fiscal year 2009.

**Figure 4: Aegis BMD SM-3 Contract for 24 Block IA Missiles Cumulative Cost and Schedule Performance**



Cumulatively, since the contract began in February 2008, the contractor is underrunning its contract's budgeted cost by \$1.4 million but is behind on \$2.1 million worth of work. The contractor attributes the cost underrun to labor efficiencies and reduced manpower within the seeker design as well

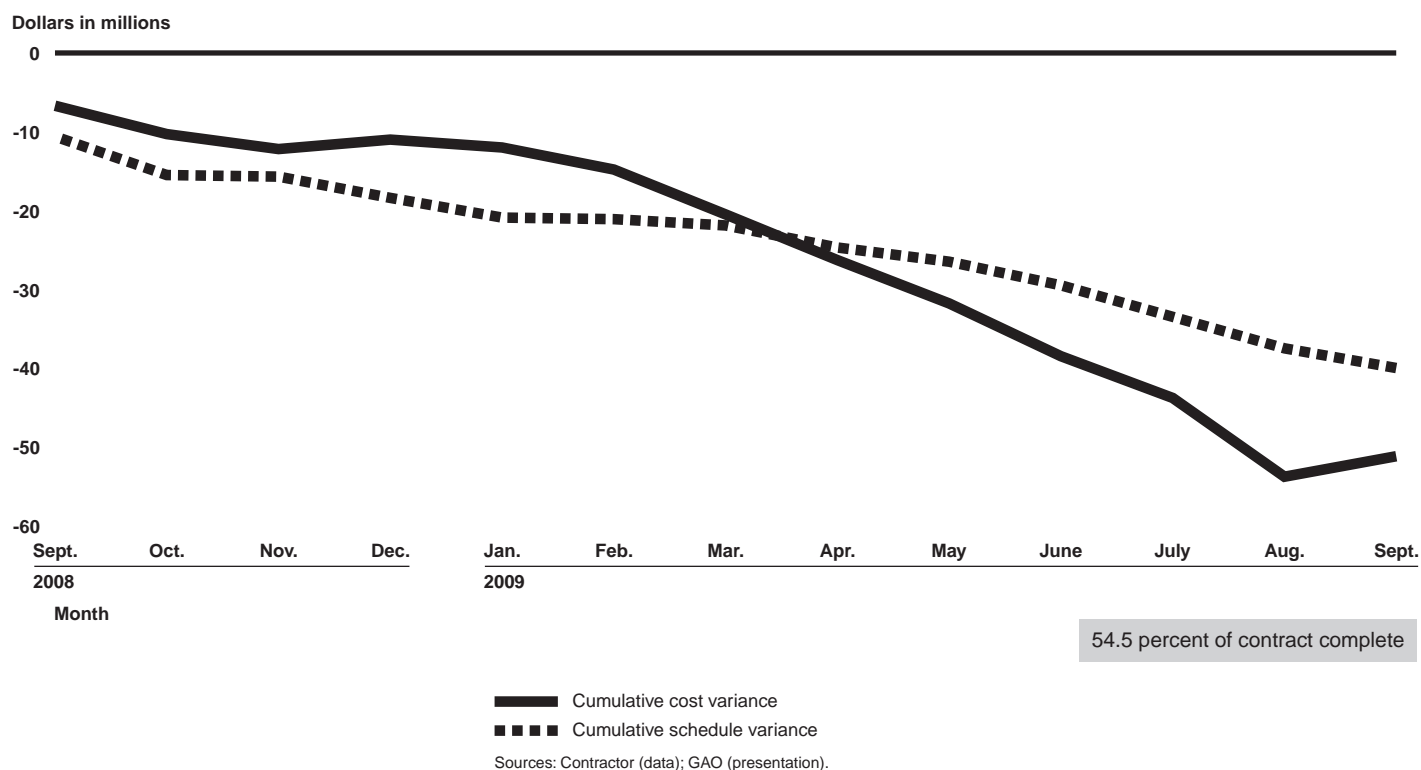
as a slower-than-planned ramp-up of some engineering efforts. The schedule delays are mainly driven by non-delivery of parts for the first stage rocket motor and late deliveries of parts associated with the third stage rocket motor. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in December 2011, the work under the contract could cost from \$15.3 million less to \$1.9 million more than the budgeted cost of \$192.6 million.

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**Aegis BMD SM-3 Block IA  
and IB Technical  
Development and  
Engineering**

For the majority of the fiscal year, the Aegis BMD SM-3 Block IA and IB Technical Development and Engineering contractor experienced a negative downward trend in cost and schedule performance. The program attributes its fiscal year cost overrun of \$44.6 million to engineering development on its Aegis BMD SM-3 Block IB throttleable divert and attitude control system being more difficult than planned. The \$29.4 million of unaccomplished work during the fiscal year was due to late receipt of materials that drove delays in some of the hardware testing. See figure 5 for trends in the contractor's cost and schedule performance during the fiscal year.

**Figure 5: Aegis BMD SM-3 Block IA and IB Technical Development and Engineering Cumulative Cost and Schedule Performance**



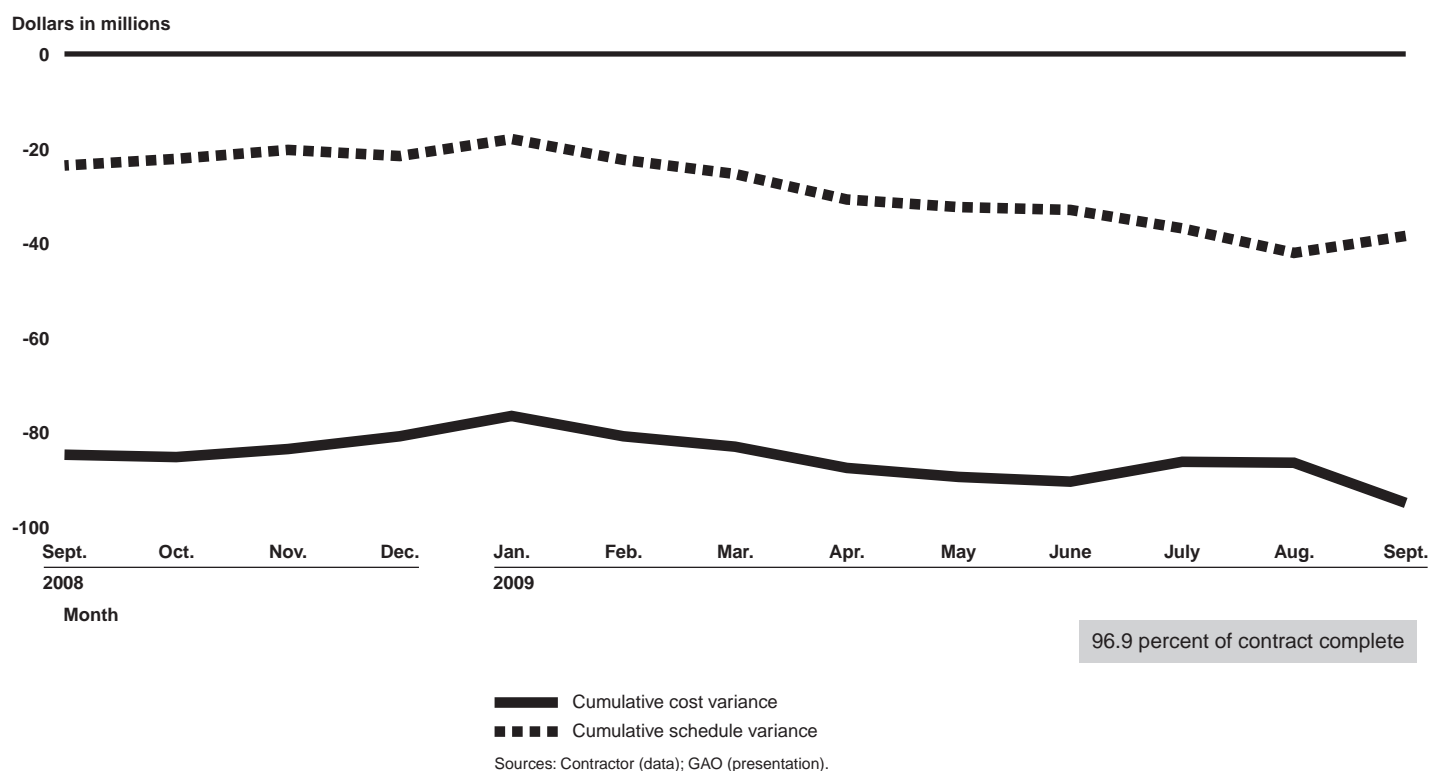
Cumulatively, since the contract began in December 2007, the program also has unfavorable cost and schedule variances of \$51.2 million and \$40.0 million, respectively. Drivers of the \$51.2 million in cost overruns are throttleable divert and attitude control system engineering and hardware major submaterial price increases in support of design reviews and demonstration unit. In addition, quality issues added to cost overruns as the contractor experienced unanticipated design changes to the nozzle resulting from foreign object debris issues. The \$40.0 million worth of work that the contractor was unable to achieve was driven by several issues, including late receipt of hardware and late production-level drawings. In addition, delays in testing for attitude control system thrusters and a quality issue that led to the contractor receiving nonconforming hardware also contributed to unaccomplished work. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in December 2010, the work under the contract could cost from \$94.0 million to \$194.8 million more than the budgeted cost of \$588.9 million.

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## ABL Cost and Schedule Performance Declined during Fiscal Year 2009

The ABL contractor, Boeing, experienced cost growth and schedule delays throughout the fiscal year. The contractor overran budgeted fiscal year 2009 cost and schedule by \$10.2 million and \$14.9 million respectively. The major drivers of fiscal year negative variances were technical issues and the addition of some testing that was not originally anticipated. For example, a fire suppression system failed to meet performance requirements for the laser flight test which limited the scope of the testing, added an unscheduled ground test and flight tests to ensure that the system worked properly, and increased costs. In addition, the contractor experienced a failure in some of the system's optics which required it to develop and procure new high-power optics and ultimately delayed the test schedule and increased program cost. Lastly, because of issues discovered during beam control/fire control flights, the program scheduled additional unplanned beam control flights to accomplish the necessary objectives. The contractor experienced a continuing cost and schedule performance decline, as seen in figure 6.

Figure 6: ABL Cumulative Cost and Schedule Performance



The contractor's cumulative cost variance is over budget by \$95.0 million and behind schedule by \$38.5 million from when the contract began in November 1997. The program attributes these variances to optics issues that have affected delivery and installation and caused test program delays. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in February 2010, the work under the contract could cost from \$98.0 million to \$116.8 million more than the budgeted cost of \$3.7 billion.<sup>2</sup>

<sup>2</sup> Since September 2009, the period of performance for the contract was extended to August 2010.

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## C2BMC Overrunning Cumulative Cost and Schedule

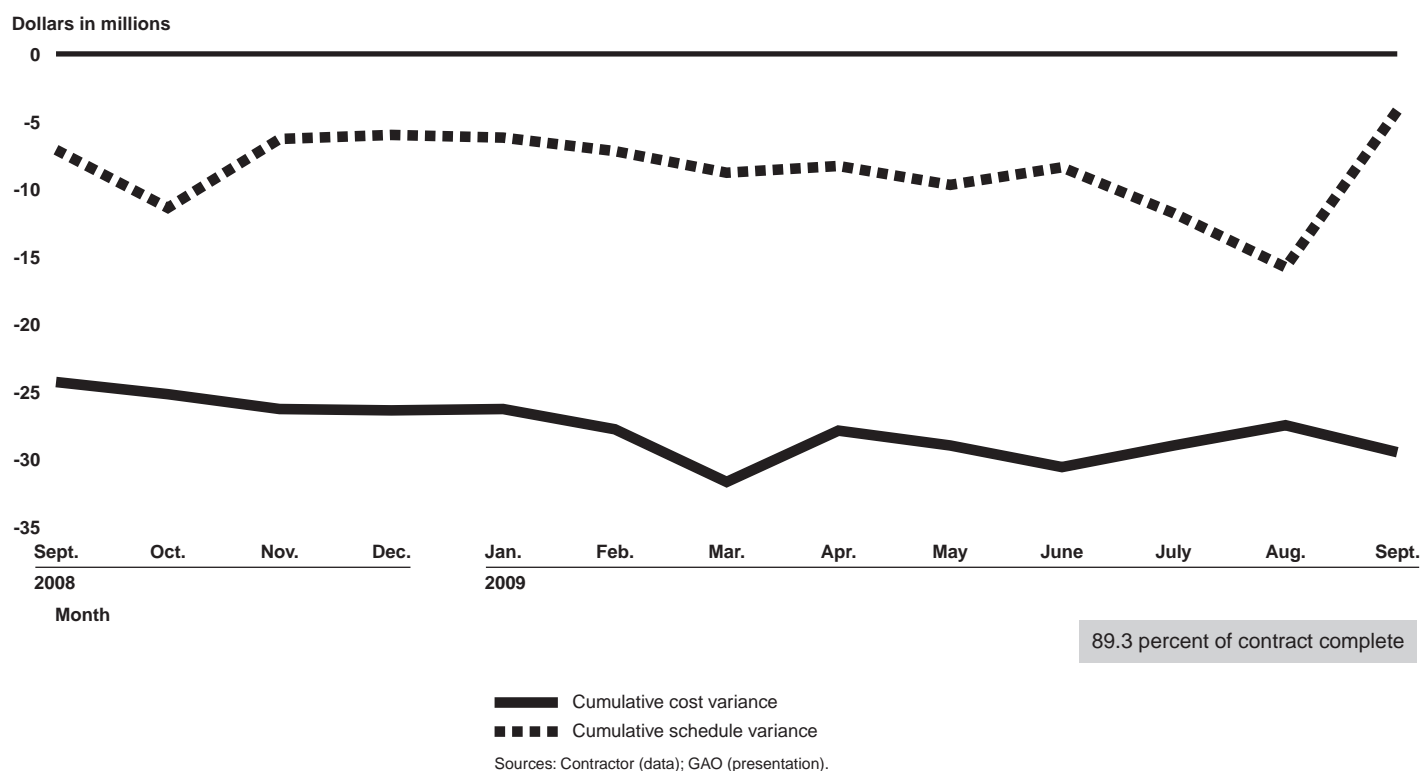
The Command and Control, Battle Management, and Communications (C2BMC) contractor, Lockheed Martin Information Systems & Global Services, is currently overrunning budgeted costs for the agreement since it began performance in February 2002 by \$29.5 million and has a cumulative schedule variance of \$4.2 million.<sup>3</sup> According to program officials, the main drivers of the cumulative variances are associated with the Part 4 and Part 5 portions of the agreement. The Part 4 effort, which began in January 2006 and finished December 2007, was for the completion of several spiral capabilities, the upgrade for spiral suites, and implementation of initial global engagement capabilities at its operations center. The Part 5 effort, which began in January 2008 and is still ongoing, covers operations and sustainment support for fielded C2BMC; deliveries of spiral hardware, software, and communications; and initiated development of initial global engagement capabilities. MDA and the contractor anticipate being able to cover cost overruns on the agreement with the nearly \$39 million in management reserve set aside by the contractor.

Part 5 accounts for nearly \$10.4 million of the \$29.5 million in negative cumulative cost variances. These budgeted cost overruns are driven by increased technical complexity of Spiral 6.4 development, and more support needed than planned to address requests from the warfighter for software modifications. The \$4.2 million of unaccomplished work on the agreement is driven by efforts in the Part 5 portion of the agreement, including delays in system level tests, late completion of C2BMC interface control document updates, and unexpected complexity of algorithm development and network design. See figure 7 for an illustration of cumulative cost and schedule performance during fiscal year 2009.

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<sup>3</sup> The C2BMC element operates under an Other Transaction Agreement with cost reimbursement aspects. These types of agreements are not always subject to procurement laws and regulations meant to safeguard the government. MDA chose the Other Transaction Agreement to facilitate a collaborative relationship between industry, government, federally funded research and development centers, and university research centers. For the purposes of this report, we have included this agreement in our analysis of BMDS contracts.

Figure 7: C2BMC Cumulative Cost and Schedule Performance



The contractor overran its fiscal year 2009 budgeted cost by \$5.2 million but is \$2.9 million ahead of schedule. The drivers of the unfavorable fiscal year cost variance of \$5.2 million are complexities associated with Spiral 6.4 development, additional design excursions, and additional costs to address system modifications requested by the warfighter. The contractor achieved a favorable fiscal year schedule variance largely because of gains in the month of September 2009. During this month, the contractor performed a replan of its work content and a future spiral's scope was removed from the Part. This replan eliminated approximately \$10 million in schedule variances for labor and materials because the work was no longer to be performed. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in December 2011, the work under the agreement could cost from \$26.5 million to \$33.1 million more than the budgeted cost of \$1.0 billion.

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## Sensors Contractor Experienced Mixed Performance during the Fiscal Year

This year we are reporting on three contracts under the Sensors program—the Ballistic Missile Defense System (BMDS) Radars contract on which we have reported in prior years, the Terminal High Altitude Area Defense (THAAD) fire unit radar #7 contract, and the Thule radar contract. During fiscal year 2009, the Sensors' contractor, Raytheon, experienced declining cost and schedule performance on the Thule radar and Army Navy/Transportable Radar Surveillance—Model 2 (AN/TPY-2) radar #7 contracts, but had favorable cost and schedule performance on the BMDS Radars contract.

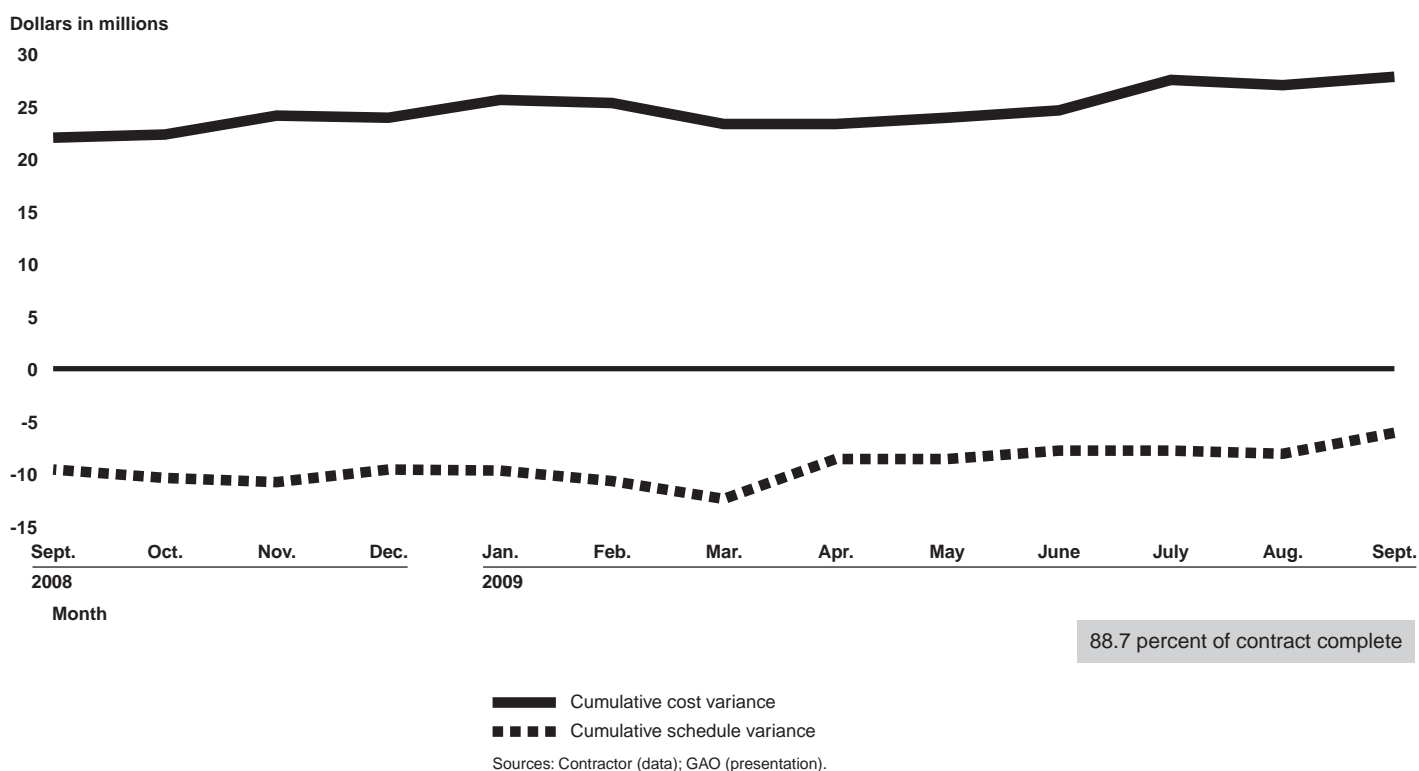
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## BMDS Radars

Throughout fiscal year 2009, the BMDS Radars contractor exhibited improved cost and schedule performance. The contractor was able to perform \$5.8 million under budgeted cost and \$3.5 million ahead of schedule for the fiscal year. The drivers of the contractor's improved cost performance are efficiencies in the software development and systems engineering. The contractor reports that the improved schedule performance is due to software schedule improvement as well as completion of manufacturing and integration testing on one of the radars. The variances, depicted in figure 8, represent the BMDS Radars contractor's cumulative cost and schedule performance over fiscal year 2009.



Figure 8: BMDS Radars Cumulative Cost and Schedule Performance



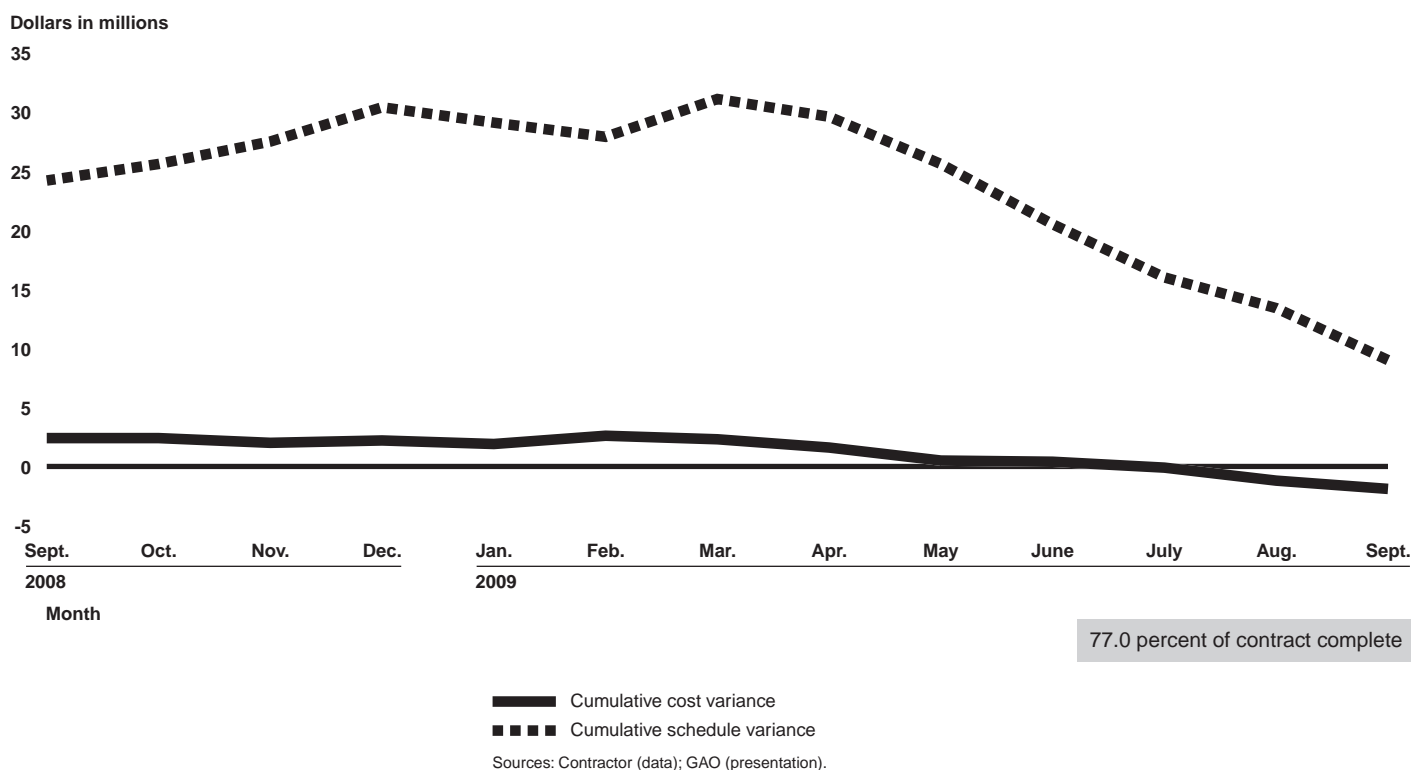
Since the contract began in March 2003, the BMDS Radars contractor is under budget by \$27.8 million but is behind on accomplishing \$6.1 million worth of work. The favorable cost variance of \$27.8 million is driven by the use of less manpower than planned and the benefit of lessons learned from previous radar software builds. The unfavorable \$6.1 million of unaccomplished work was driven by the late start on restructuring the latest software release and rework and subcomponent delays with one of the radars. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in August 2010, the work under the contract could cost from \$31.3 million to \$43.0 million less than the budgeted cost of \$1.2 billion.

## AN/TPY-2 #7 Radar

The AN/TPY-2 radar #7 contractor experienced unfavorable fiscal year 2009 cost and schedule variances of \$4.3 million and \$15.2 million, respectively. As of September 2009, the AN/TPY-2 radar #7 contract had overrun its budgeted cost by \$1.9 million but was ahead in completing \$9.0

million worth of work. Contributors to the cumulative cost overruns included supplier quality issues that required an increase in supplier quality support that was not in the original baseline. In addition, the program's prime power unit purchase orders were over budgeted cost because the budgeted cost for four of the prime power units was prematurely established before the design of the first prime power unit was finalized. These delays caused some uncertainty in the final production costs until the design was finalized. As of August 2009, the contractor was working to develop a cost model and establish a true unit cost price per prime power unit. Trends in cost and schedule performance during the fiscal year are depicted in figure 9.

Figure 9: AN/TPY-2 Radar #7 Cumulative Cost and Schedule Performance



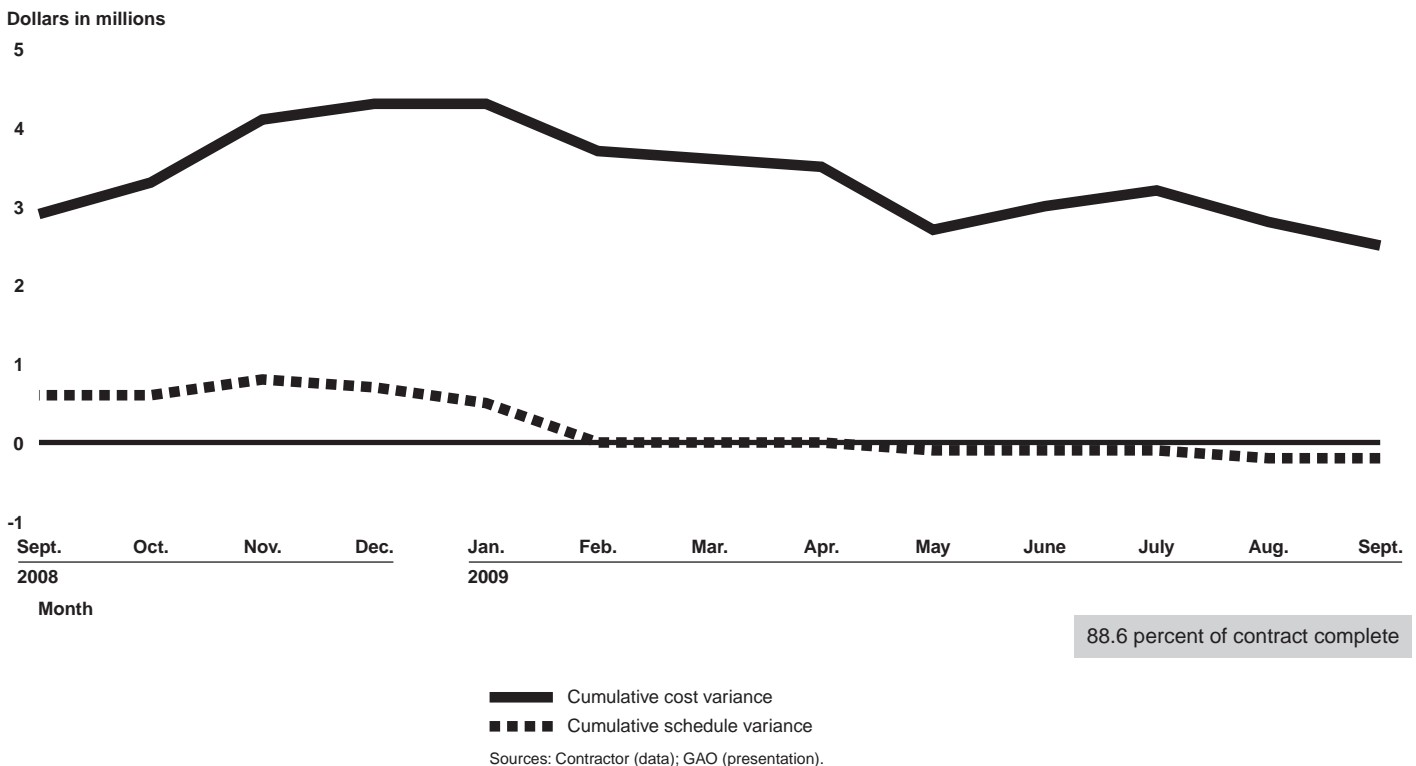
Cumulatively, since the contract began in February 2007, the AN/TPY-2 Radar #7 contractor has completed \$9.0 million worth of work ahead of schedule on this contract by executing work ahead of the contract baseline plan in some areas, including obtaining materials for equipment supporting radar operation. If the contractor continues to perform as it did

through September 2009, our analysis projects that at completion in April 2010, the work under the contract could cost from \$0.3 million less to \$36.9 million more than the budgeted cost of \$172.5 million.

## Thule Radar

The Thule radar contractor overran fiscal year 2009 budgeted costs by \$0.4 million and was unable to accomplish \$0.8 million worth of work. The contractor attributes the cost overruns to exceeding planned engineering efforts in order to proactively work on issues prior to equipment delivery and ship readiness. The unfavorable schedule performance is due to the contractor expending some of its positive schedule variance in 2008 and from being behind schedule on the implementation of information assurance requirements. Figure 10 shows cumulative variances at the beginning of fiscal year 2009 along with a depiction of the contractor's cost and schedule performance throughout the fiscal year.

**Figure 10: Thule Radar Cumulative Cost and Schedule Performance**



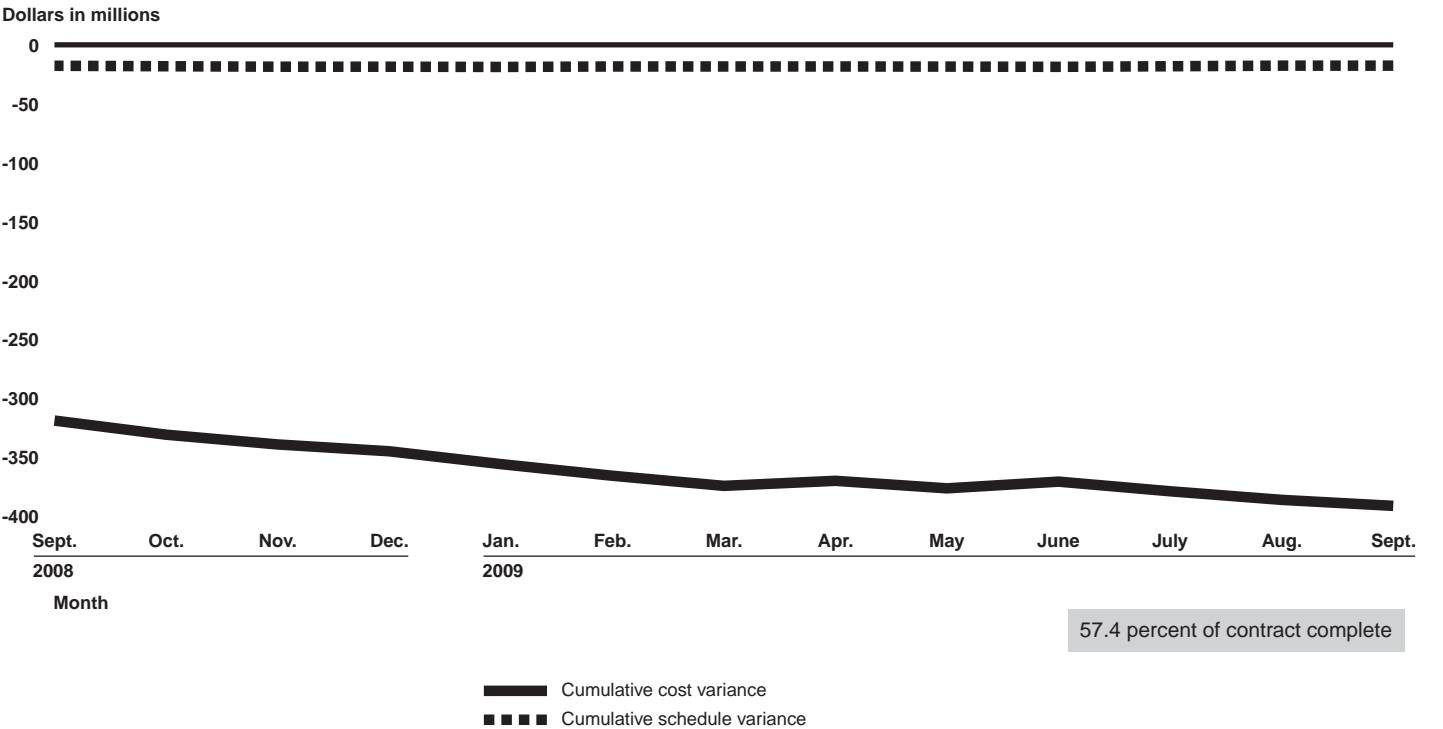
The Thule radar contractor, since it began performance in April 2006, is underrunning budgeted costs by \$2.5 million and overrunning schedule by \$0.2 million. Underruns in hardware, manufacturing, and facility design, construction, and installation drove the \$2.5 million in cost underruns. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in September 2010, the work under the contract could cost from \$1.4 million to \$2.8 million less than the budgeted cost of \$101.9 million.

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**STSS Maintained  
Schedule  
Performance, but  
Cost Performance  
Continued to Decline  
during the Fiscal Year**

During fiscal year 2009, the Space Tracking and Surveillance System (STSS) contractor, Northrop Grumman, was able to accomplish \$0.1 million more worth of work than originally anticipated, but overran budgeted costs by \$72.6 million. The contractor reports that the favorable schedule variances are due to completed space vehicle 1 and 2 shipment, setups and validations, and launch. In addition, the contractor overran budgeted fiscal year costs because of additional support required to support launch operations including addressing hardware anomalies, payload integration, procedure development, and launch site activities. Additional support was also required to support the delays to the launch date beyond the original plan. See figure 11 for an illustration of the cumulative cost and schedule variances during fiscal year 2009.

Figure 11: STSS Cumulative Cost and Schedule Performance



Sources: Contractor (data); GAO (presentation).

Note: The STSS contract includes line items for work that do not necessarily apply to the satellites that were launched in the fourth quarter of fiscal year 2009. Removing these line items from our analysis, the program's contract would be considered 84.1 percent complete.

Despite the small gains in schedule variances during the fiscal year, the contractor maintains cumulative negative cost and schedule variances of \$391.8 million and \$17.7 million respectively from the contract's inception in August 2002. Drivers of the \$391.8 million in contract cost overruns are for labor resources exceeding planned levels and unanticipated difficulties related to space vehicle environment testing, hardware failures and anomalies, and program schedule extension. In addition, space vehicle-1 testing, rework, hardware issues, and sensor testing anomaly resolution as well as space vehicle-2 anomalies and testing have also contributed to the unfavorable cost variances. System test and operations and program management experienced cost overruns because of launch date schedule extensions. Lastly, ground labor resources exceeded planned levels because of the unanticipated need for a new ground software build and ground acceptance and verification report activities. The contractor has been unable to accomplish \$17.7 million worth of work on the contract

because of launch schedule delays, delays in verification of system requirements caused by late space segment deliveries, and tasks slipping in response to fiscal year 2009 funding reductions. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in September 2010, the work under the contract could cost from \$620.9 million to \$1.6 billion more than the budgeted cost of \$1.6 billion.

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## THAAD Development Contract Overran Cost and Schedule While THAAD Fire Unit Fielding Production Contract Experienced Underruns

This year we report on two THAAD contracts—the development contract and the fire unit fielding production contract. As the contractor for both of these contracts, Lockheed Martin Space Systems Company was overrunning budgeted cost and schedule on the THAAD development contract but remained under cost and ahead of schedule on the THAAD fire unit fielding production contract.

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### THAAD Development

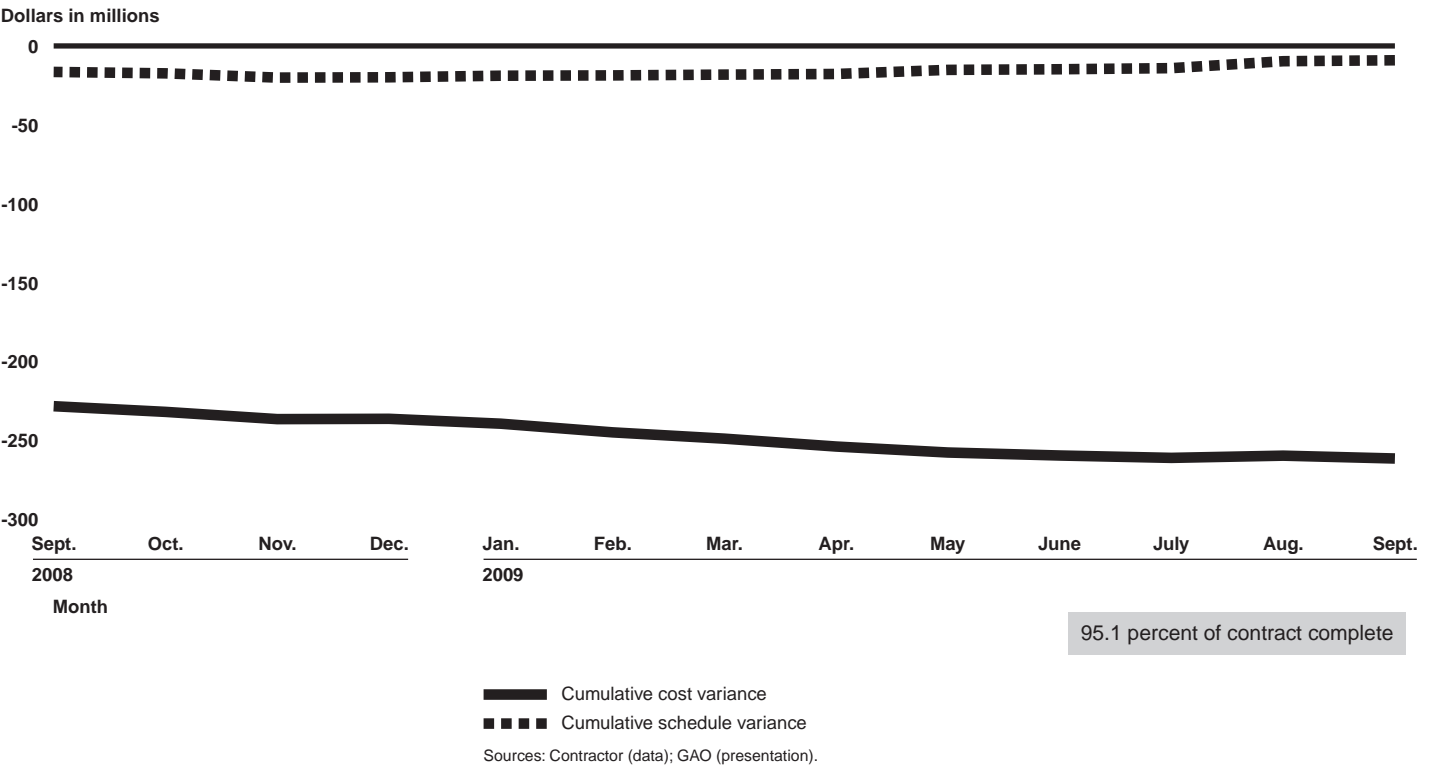
During fiscal year 2009, the THAAD development contractor overran its budgeted cost by \$33.1 million but was ahead on completing \$7.4 million worth of work.<sup>4</sup> The fiscal year cost overruns are mainly in the missile, launcher, and radar portions of the contract. The missile experienced overruns on divert and attitude control system assembly redesigns, correcting issues with its boost motor, and making changes on the design of its optical block—a safety system to prevent inadvertent launches. The contractor spent more than expected during the fiscal year on the launcher portion of the contract, investing in labor and overtime to recover schedule. Lastly, the prime power unit in the radar portion of the contract required extended testing and redesign, which also contributed to fiscal year costs.

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<sup>4</sup> Earned value data for the THAAD development contract is reported under two contract line item numbers—1 and 10. We report only the contractor's cost and schedule performance for contract line item number 1 because it represents the majority of the total work performed under the contract. Contract line item number 10 provides for Patriot Common Launcher initiatives funded by the Army's Lower Tier Program Office.

Despite fiscal year cost overruns, the contractor was able to accomplish \$7.4 million more worth of work than originally anticipated also in the missile and launcher portions of the contract. The schedule variance improved in the missile portion because of completion of missile qualification work. The contractor was also able to complete software activities and resolve hardware design and qualification issues in the launcher. See figure 12 for trends in the contractor’s cost and schedule performance during the fiscal year.

Figure 12: THAAD Development Cumulative Cost and Schedule Performance



Although the contractor made some schedule gains during the fiscal year, overall the contractor since it began performance in June 2000 is behind on \$9.1 million worth of work. The radar’s portion of unfavorable schedule variance is driven by delays to THAAD flight test missions during fiscal year 2009. In addition, the fire control’s software qualification testing had to be extended because of the number of software changes and because the welding on the fire control power distribution unit’s chassis failed weld inspection and was subsequently unusable which contributed to the

unfavorable schedule variance. The launcher experienced design delays and quality issues that led to nonconformances in delivered hardware. This hardware subsequently required investigation and rework, which also added unexpected work to the schedule. Lastly, the program was unable to accomplish work in the missile component's flight sequencing assembly component because qualification tests were delayed due to failures with the optical block switch.

The unfavorable fiscal year cost variances added to the overall cost overruns of \$261.9 million. The contractor attributes overruns to the missile, launcher, and radar portions of the contract. The missile's unfavorable cost variance is driven by unexpected costs in electrical subsystems, propulsion, and divert and attitude control systems. Also contributing are issues associated with the optical block, range safety, communications systems, and boost motors. The launcher has experienced cost growth because of inefficiencies that occurred during hardware design, integration difficulties, quality issues leading to delivered hardware nonconformances, and ongoing software costs being higher than planned because of rework of software to correct testing anomalies. These problems resulted in schedule delays and higher labor costs to correct the problems. In addition, cooling and power issues with the radar have contributed to overruns with the prime power unit. Numerous fan motor control system redesigns and retrofits for the cooling system drove costs by the supplier. Inexperience with building a prime power unit and a limited understanding of the true complexity and risks associated with the system led to significant cost growth and delivery delays. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in January 2011, the work under the contract could cost from \$267.2 million to \$287.4 million more than the budgeted cost of \$4.8 billion.

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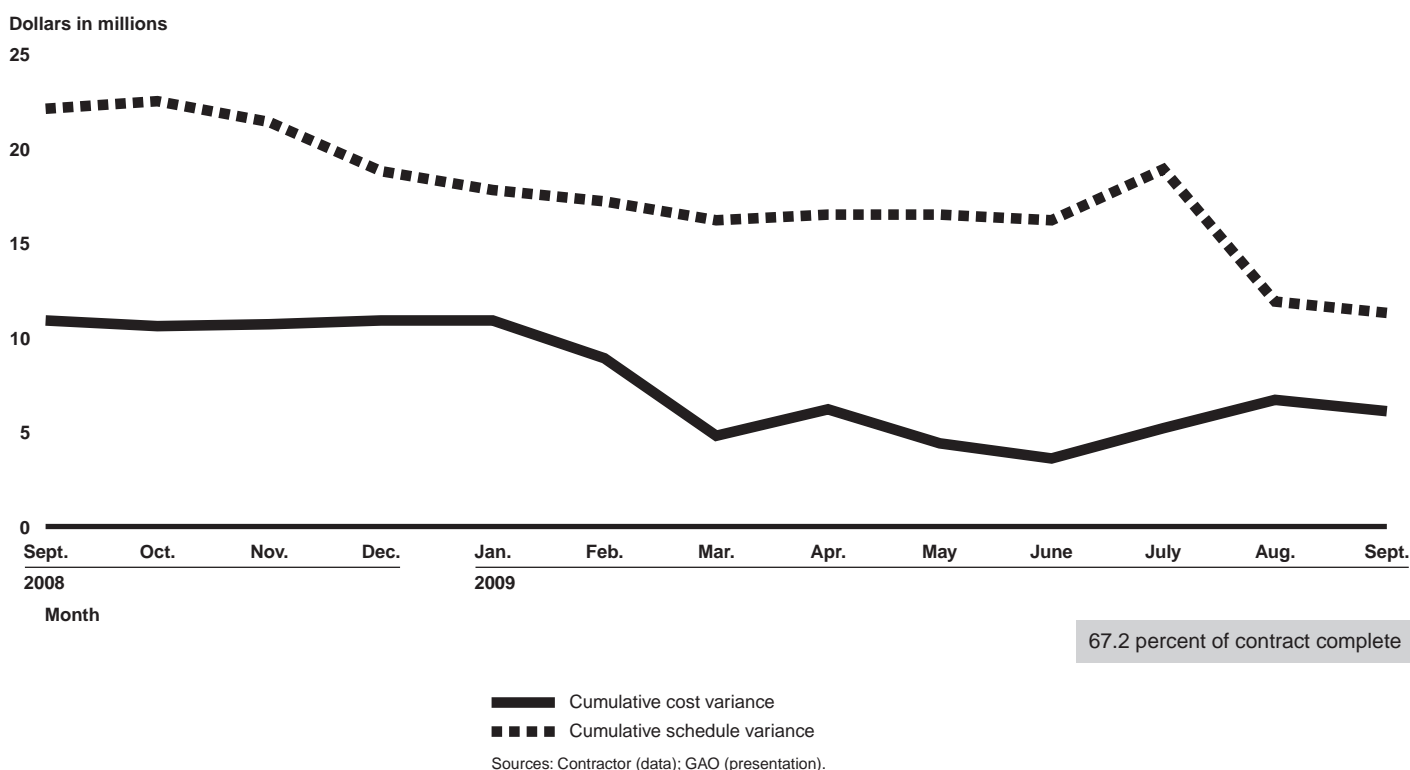
### THAAD Fire Unit Fielding Production

The THAAD fire unit fielding production contractor overran fiscal year 2009 budgeted cost and schedule by \$4.7 million and \$10.7 million, respectively. The fiscal year cost and schedule overruns were caused primarily by the missile and fire control components. Unfavorable missile cost and schedule variances were the result of hardware failures associated with components of the inertial measurement unit, communications transponder, and the boost motor causing delays and rework. In addition, the fire control portion of the contract experienced overruns because of unplanned engineering design changes and labor associated with fire control hardware and issues identified during testing. These changes were made to the hardware and deliveries already



completed. See figure 13 for an illustration of cumulative cost and schedule variances during the course of the fiscal year.

**Figure 13: THAAD Fire Unit Fielding Production Cumulative Cost and Schedule Performance**



Despite fiscal year overruns, the fire unit production contractor continues to underrun its total contract cost and schedule. The contractor, since it began performance in December 2006, is currently \$6.1 million under budgeted costs and has completed \$11.3 million more worth of work than originally anticipated. The cost underruns are primarily due to a slow start-up on fire unit fielding level of effort activities. Schedule variances are not reported on level of effort activities, so delaying these activities would save on costs without affecting reported schedule. However, these false positive cost variances will erode over time once the work gets accomplished. When planned level of effort work is not performed, EVM metrics are distorted because they show cost savings for work that has not yet been accomplished. However, once the work is finished, large unfavorable cost variances will be revealed since the program will need to expend funds to accomplish the work for which it has already received

credit. In addition, the program reports its favorable schedule variances are due to the transfer of excess interceptor hardware from the development contract to the fire unit fielding contract. Although the favorable schedule variance from this transfer of hardware is nearly \$23.0 million, offsets occurred from delayed interceptor build activity driven by multiple supplier hardware issues and schedule delays because of issues with the boost motor including unplanned replacement of motor cases, delayed case fabrication, and slowed operations caused by a safety incident at a production facility. If the contractor continues to perform as it did through September 2009, our analysis projects that at completion in August 2011, the work under the contract could cost from \$1.3 million to \$17.9 million less than the budgeted cost of \$604.4 million. However, it should be noted that the projection of the estimated cost at completion may also be overestimated because it is based on current cost performance that is inflated because of level of effort activities and schedule performance which are inflated by transfers of materials from another contract.

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# Appendix III: Scope and Methodology

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To examine the progress Missile Defense Agency (MDA) prime contractors made in fiscal year 2009 in cost and schedule performance, we examined contractor performance on 14 Ballistic Missile Defense System (BMDS) element contracts. In assessing each contract, we examined contract performance reports from September 2008 through October 2009 for each contract, including the format 1 variance data report, cost and schedule variance explanations included in the format 5, and format 2 organizational category variance totals where available. We performed extensive analysis on the format 1 of the contract performance reports in order to aggregate the data and verify data reliability.

To ensure data reliability, we performed a series of checks based on consultation with earned value experts and in accordance with GAO internal reliability standards. We began by tracking which earned value management (EVM) systems that produced the contract performance reports were compliant with American National Standards Institute standards in 2009 by reviewing the certification documentation. We received this documentation through the Defense Contract Management Agency (DCMA), which performs independent EVM surveillance of MDA contractors. We then reviewed the latest integrated baseline review out-briefs for the BMDS elements' contracts to examine the earned value-related risks that were identified during the review and followed up with the program office to see which, if any, risks were still open action items.

To further review the contract performance report format 1 data, we performed basic checks on the totals from contract performance report format 1 to ensure that they matched up with organizational totals from the contract performance report format 2, where available. This check enabled us to review whether the earned value data were consistent across the report. In addition, we obtained a spreadsheet tool from GAO internal earned value experts to perform a more extensive check of the data. Using this tool, we ran various analyses on the data we received to search for anomalies. We then followed up on these anomalies with the program offices that manage each of the 14 BMDS element contracts. We reviewed the responses with GAO EVM experts and further corroborated the responses with DCMA officials.

We used contract performance report data in order to generate our estimated overrun or underrun of the contract cost completion by using formulas accepted by the EVM community and printed in the GAO *Cost*

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*Estimating and Assessment Guide.*<sup>1</sup> We generated multiple formulas for the projected contract cost at completion that were based on how much of the contract had been completed up to September 2009. The ranges in the estimates at completion are driven by using different efficiency indices based on the program's completion to adjust the remaining work according to the program's past cost and schedule performance. The idea in using the efficiency index is that how a program has performed in the past will indicate how it will perform in the future. In close consultation with earned value experts, we reviewed the data included in the analysis and made adjustments for anomalous data where appropriate.

We conducted this performance audit from February 2010 to July 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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<sup>1</sup> GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, [GAO-09-3SP](#) (Washington, D.C.: March 2009).

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# Appendix IV: GAO Contact and Staff Acknowledgments

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## GAO Contact

Cristina Chaplain (202) 512-4841 or [chaplainc@gao.gov](mailto:chaplainc@gao.gov)

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## Acknowledgments

In addition to the contact named above, David Best, Assistant Director; Meredith Kimmett; LaTonya Miller; Karen Richey; Robert Swierczek; Alyssa Weir, and John A. Krump made key contributions to this report.

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